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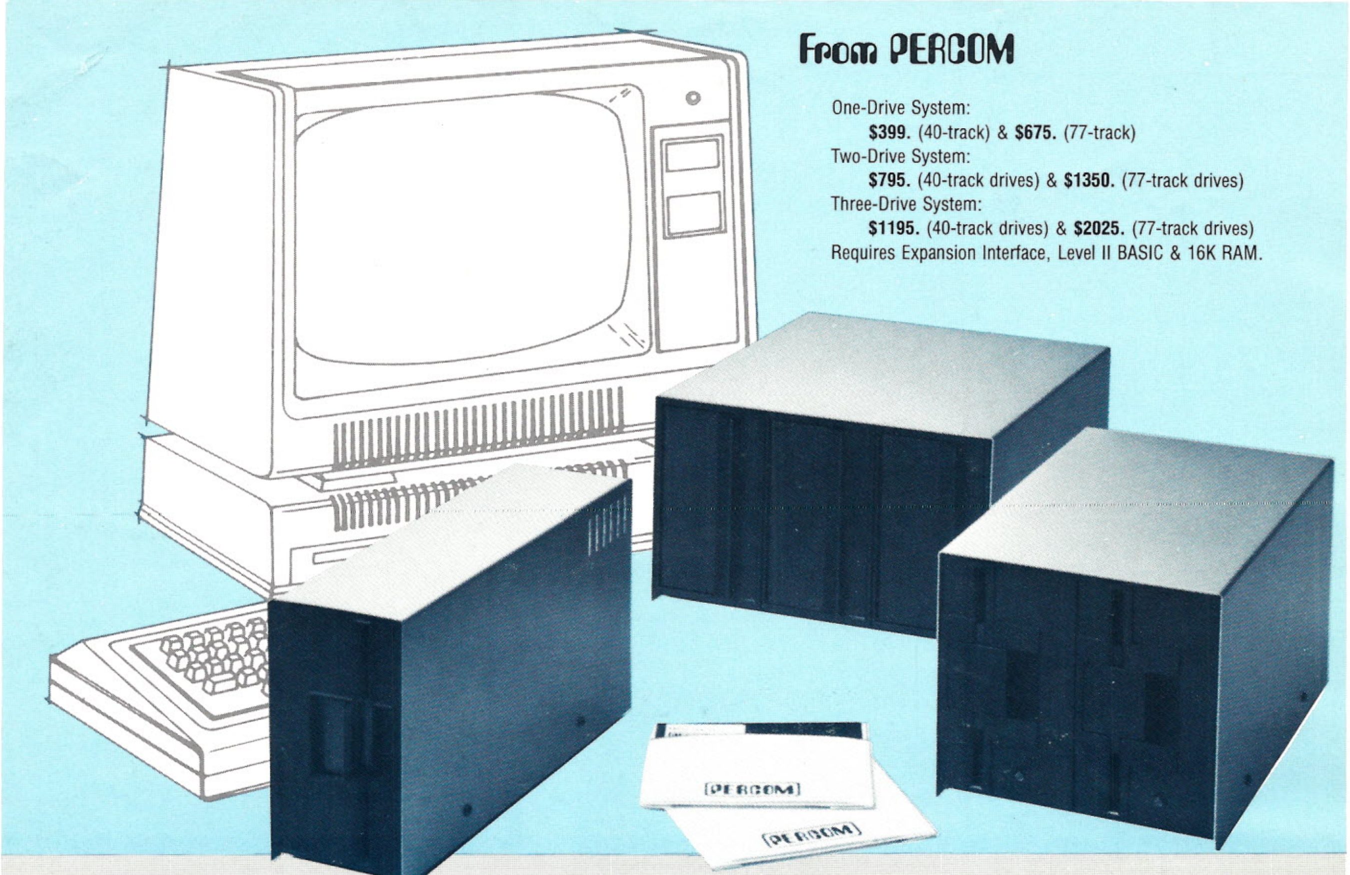

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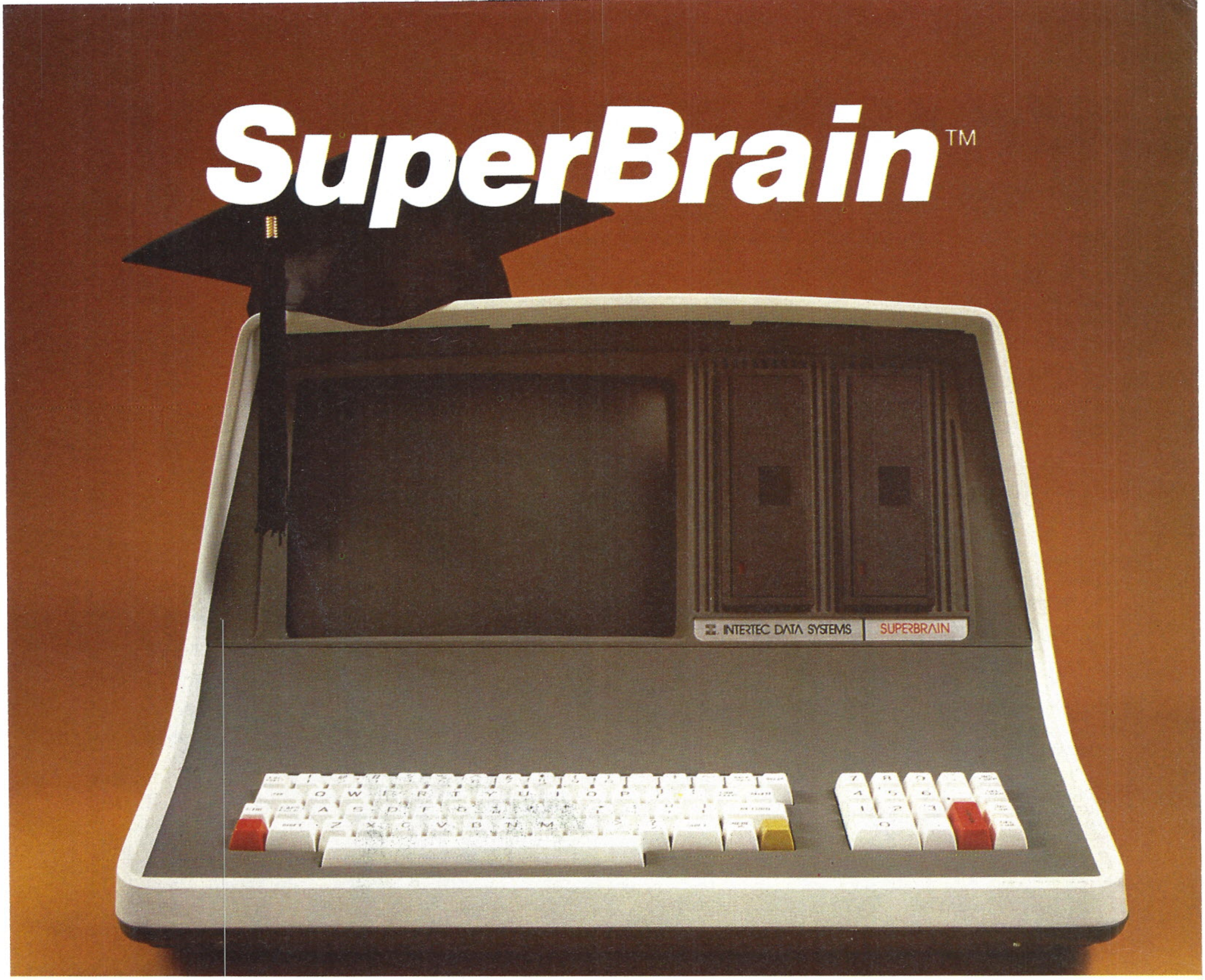

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contents: nov. '79

ARTICLES

DEPARTMENTS

Cover: A TRS-80 system in operation in the ISI lab.

micro info

This symbol next to a title in the table of contents indicates that the article is a business-application article.

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PUBLISHER'S REMARKS

Wayne Green

A Microcomputing Degree?

The other day I was having lunch with Walter Peterson, the president of Franklin Pierce College (Rindge, New Hampshire) and an ex-governor of New Hampshire. Franklin Pierce is a small college of about 1000 students and has liberal-arts and business degrees available.

Walt was concerned about the role of the small independent college in the 1980s, when it will be more and more difficult to recruit students. I'd been worrying about my own problems in getting people with any background in microcomputing as well as the problems of the industry in getting people with the background needed to keep firms alive. I'd just watched Processor Tech, Xitan, Imsai and several other major firms fold, all because of poor management, so Walt's concerns were not far from the top of my mind. The concept of a college degree in microcomputing, complete with a good business background, came to mind, and I explained it to Walt.

He liked it, and a few days later I met with him at the college and we talked with Dean Cliff Coles. I frankly did not expect a very good reception from the Dean, but much to my surprise, he agreed with me. He also felt that a college education would be better if it could prepare the student to cope with the world. Too many college graduates work as handymen, as sales clerks and as waiters . . . mostly because they came out of school with no preparation for getting a good job.

My concept for a degree course in microcomputing would start with the basics of both hardware and the software. It would start with electricity, then cover ac and dc, motors and generators, power supplies, radio circuits, digital circuits, solid state, tubes, memories, microprocessors and all of the popular microcomputer circuits and architectures. On the software side, it would cover machine language, assembly language, BASIC, FORTRAN, COBOL, PASCAL, FORTH and other popular languages, but emphasize BASIC.

On the business end, I suggested courses in accounting; statistics; purchasing; personnel management; financing; production planning; packaging; advertising; printing; graphic arts; marketing; dealing with government agencies, with unions; time and motion study; taxes; plant design; office equipment. A rounded education such as this should minimize catastrophic failures of microcomputer firms. These students would be prime candidates for chief executive officer (CEO) of any microcomputer firm.

After talking over the proposed curriculum, we looked over the school facilities. It is an impressive school, which, with some reorganization, could start quickly with many of the required classes. The college has room for perhaps 250 more students before more living space will have to be constructed.

Any college professors who teach computing and think this is not only a good idea, but are interested in participating, could do worse than contact me or Walt Peterson. Experienced microcomputer teachers and even someone with the right background to run the department would be needed.

In addition to turning out students with an ideal education to help our field of microcomputing grow, the college would also be able to offer short courses in microcomputer technology that would result in a technician certificate . . . or a software course that would equip a person to be a programmer. And think of the courses during the summer for large-computer-system executives to acquaint them with microcomputers and the microcomputer industry. I suspect that an instructor and a couple of senior students could give weekend crash courses in many different aspects of microcomputing and the industry.

I think that with some effort Franklin Pierce could be known worldwide as a center for microcomputer training. With thousands of high-school students interested in microcomputers, I doubt if there would be any shortage of prospective students for the courses and the degree.

Setting up the classes wouldn't be too difficult; several of the proposed business courses are already being taught. The main problem initially would be the need for a computer lab. Since our Instant Software lab is not far from the college, I proposed that this lab could be used until the college was able to set up and run its own lab. We have over $100,000 in microcomputer equipment, so it would be a good start.

The college might obtain additional help from firms in the industry. For instance, microprocessor manufacturers would have a vested interest in students' having an intimate understanding of their products. These students will be the future leaders of the industry, so if they know only Motorola products, guess what they will be specifying later on. The tax dollars needed to fund a new building and computer equipment would be well invested.

Since Radio Shack is the largest in the business, they would want to be sure that the school had plenty of their equipment on hand for students to use and know. Let's see, how about a Tandy Computer Lab building?

Any high-school students who want more information about Franklin Pierce, write to the college in Rindge NH.

Meanwhile, I'll be outlining some of the courses I think would be best for the future CEO in microcomputing. For example, an advertising course should cover all aspects of advertising. It should also cover the elements of writing an ad, designing it and measuring its effectiveness. If many of the firms in the industry had taken the small amount of time and effort needed to test the effectiveness of their ads, I think they would be around today.

There's been enough failure in this fast-growing industry. Now we need some professionals to join our businesses and eventually run them, and I think a college such as Franklin Pierce may be just the answer.

Software Rip-off

Although *Kilobaud Microcomputing* did not exhibit at the New York computer show, Sherry, Kevin (the advertising department) and I did drive down to see what was happening.

It was a strange show. I wasn't surprised to see a Radio Shack computer center, with an island exhibit, or Data General and DEC (I think they've noticed the interest in small business computers). Exidy was there in more force than last year, when Paul Terrell had a corner of a dealer booth; this time there was a small island exhibit. And Commodore was there!

DEC seemed more interested in getting employees than selling anything. And there were the usual head-hunters, leasing firms, stock-exchange people and other more business-oriented exhibits. Other than that I saw mostly dealer exhibits and some small software firms.

Sherry picked up some programs to review. We've been wanting to have more information in the magazine about published software, and not just Instant Software. Few software firms have discovered that they can have their products reviewed if they submit them, and we would be delighted to publish some enthusiastic reviews.

When we were back in New Hampshire, Sherry loaded the programs, and a short while later called to me in distress. She had a $9.95 program from a major firm, and I could hardly believe what I was seeing: prime numbers, perfect numbers, Fibonacci numbers, Armstrong numbers. Who cares?

In order to encourage the production of better software, I'm asking readers who have lucked into some good programs to please take the time to write them up briefly and let the rest of us know that we can buy them and get our money's worth. And if anyone finds an Instant Software program that isn't worth a lot more than he paid for it, I want to know about that, too.

If you run into rip-off programs, I'd like to hear about them too . . . and I'll contact the publisher. We'll try to improve the breed of programs by encouraging the good ones.

More Needed Programs

How much would a medium-size or even a small business pay for a series of programs that would help evaluate job applicants? The applicant could answer the questions on the computer, and then the personnel manager (or owner) of the firm could have the computer produce an evaluation that would include some hint on intelligence, vocab-

ulary, interests, enthusiasm and aptitudes of the applicant.

This idea was prompted by my receiving a mailing from a firm that, for $70, will give you a test for employee prospects and evaluate it for you.

This type of testing could be expanded to include simulated SATs (scholastic aptitude tests) and other standardized tests for jobs and school levels. It's one thing to learn a subject and another to be well prepared for passing a test. How about some simulated FCC ham ticket tests?

Working at Home

With almost 900 associate editors signed up for work with Instant Software programs, I thought we had that situation covered. Now I understand that we still need associates in some categories.

There is no shortage of people with the expertise to check out game programs, but when it comes to business-application programs and scientific programs, we still don't have enough people. We need real estate operators who have microcomputers and some expertise in programming to help us check out real estate programs.

The same situation holds in many other specialized areas. We want to be sure that legal programs, for example, are checked out by lawyer-programmers. We got a call from a chemical magazine wanting to know the names of chemists using microcomputers. We found people who had signed up as associate editors and listed chemistry as their specialty, but all of them were school teachers or students . . . no one actually in the business. Obviously, we need people with some practical industry background to help evaluate special programs for all businesses.

When I originally asked for volunteers for this project, we did not look for people with the background and hardware to make program conversions from one system to another. Now we'd like to do that, yet we can't tie up the few people we have on hand with the time-consuming conversions. If you have two different systems and are interested in converting a program from one to the other, please let me know. The work is done at your leisure and with your own equipment. Authors will be given the first chance at translating their programs for other systems, but beyond that we'll need the help of associate editors. We're anxious to support as many different systems as we can with software, so let me know what systems you have available.

There is a growing need for foreign-language translations of both the programs and our instruction books. If you are interested in this project, let me know.

We pay $3 per hour for program evaluation. The fun involved seems to make this attractive, and our present associate editors are enjoying their "work" and finding the money a pleasant plus. Editors who translate programs for other microcomputer systems normally get a percentage of the action, which we hope will be far more than $3 per hour. This also holds for foreign-language translations . . . we're looking for Spanish, Portugese, Italian, French, German, Danish, Swedish, Finnish, and any other languages used in countries where microcomputers are being sold.

The translations for different machines can be difficult if graphics are involved. This usually means sitting down and starting all over because no two graphic systems are even remotely compatible . . . nor even computer translatable. I suspect that we may eventually get some programs that will change a TRS-80 program to run on a PET—as long as there are no graphics.

OUTPUT FROM ISI

Sherry Smythe

The microcomputer business seems to be more than recession-proof; it seems to be thriving on a recession. It isn't until the cash flow starts to be a problem that many firms look around frantically for ways to cut costs and keep things going despite a drop in sales. Low-cost computers which can do the work of several people, yet which cost less than a half person on the payroll, are very attractive to cash-short businesses.

Since none of these computers can do anything without programs, Instant Software is doing just fine. We're hiring one or two new people a week and still looking for more. We're already outgrowing our present facilities and have new warehouse and production space on the drawing board.

Recommended Configuration

TRS-80 systems with dual disks and at least 16K of memory are now generally available, constituting a good system for writing business-oriented programs. The lab people tell me that they are having the best results right now with the above hardware plus the Apparat NEWDOS+ operating system (see the review of NEWDOS+ in this issue). This is presently the recommended configuration for producing programs for the TRS-80 system. Business programs have a decided priority with ISI right now, so programmers will do well to think in these terms.

Foreign Software Sales

Instant Software sales in Europe are moving ahead rapidly under the direction of Reinhard Nedela in Markdorf, W. Germany. Programs in German are already being sold, and Italian translations are now in production. French and Spanish versions are being written. In order to keep up with the growing European sales, we've started plans for a production facility in Europe—probably in Ireland. We're open to any information that will help us select a site for the European production of software.

Increasing pressures from Asia for Instant Software may result in distribution of our programs there. We'll be checking into the prospects during our October trip to Japan, Taiwan, Korea and Hong Kong. We'll also be watching for any hardware that may be coming to the U.S. market, and Wayne will report on that.

Programmers with Japanese, Hebrew or other foreign ROMs can translate Instant Software programs. Write to us and ask about the associate-editor program and translating. You get a percentage of the royalties for this work.

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Domestic News

On a recent trip around our country introducing Instant Software to computer and Radio Shack Associate stores, I found that many of these entrepreneurs had been working with local programmers developing business-oriented programs. They were excited about the prospects of having these programs, which had already been paid for, marketed by Instant Software for a royalty. It's a gold mine. I ran into programs for teaching children in kindergarten, for managing a wild animal hunting preserve, for examples. Since the marketing through Instant Software doesn't in any way prevent further individual sales by the programmer, the ISI sales are just gravy.

I did run into a dealer who was grousing that Instant Software would not accept returns of programs that did not sell. He had assumed this, but had never even asked. We're out to make things easy, not difficult, for dealers. We even have a little scheme that may help dealers set up and display Instant Software on a partial-consignment basis. Dealers can watch the "MICROCOMPUTING Industry Newsletter" for further word on this.

Last month's editorial about opportunities for reps in this new field brought a favorable response, and several areas are now starting this program. Now that there are over a hundred programs to sell—and an average of one new program package emerging from our lab every working day—this is becoming a big business.

Other than that, Wayne and I will be looking forward to seeing you and answering your questions at shows. We will be visiting Winter CES in January . . . probably the Faire in San Francisco in March. Wayne will be on the program at the St. Louis show, May 24, and will be able to answer any questions. Don't miss that one.

COMPUTER CLINIC

A generous person donated a Studio II (see June 1979, p. 18) unit to our Coast Guard auxiliary, but unfortunately it does not have a working instructional plan or a schematic. Does anyone know how to obtain these?

Milton Greene
Communications Officer
St. Croix Coast Guard Aux.
Box 2759, Christiansted
St. Croix USVI 00820

I have a substantial investment in Imsai equipment, particularly VDP 44s. One problem we continue to have is trying to locate the following: an accurate and readily available list of programs written in FORTRAN. Since we are a business user, this is very important. We have repeatedly been told that a large number of programs in the public domain are available through some part of the United States Government Printing Office. However, to date, we have not been able to find out who provides this information. I would appreciate any information in either of these areas.

E. M. McCartt
Statewide Mortgage Corp.
10042 San Pablo Ave.
Cerrito CA 94530

I am building a Super Elf and would like to pick the brains of any local Elf owners, or otherwise consult, commiserate or exchange views with same.

Lee Davis
1142 Oakwood
Wilmette IL 60091

I bought an Apple II last year in the hope that it would bring order out of chaos in the collected documentation I have of several thousand ancestors. I would like to be able to store, file, sort, retrieve and cross-reference genealogical data. I would like to be able to have pedigree, individual and family group printouts as well as indexes. The Mormons have done excellent work, but they use IBM 370s. Some work out of the University of Utah has focussed on minis using an excellent soundex code with pointer systems for parents and progeny, but the adaptation to micros is not clear.

I would like to hear from others of a similar interest (it also has relevance to tracing genetic disorders, and there are other analogs) so that possibly a network of information could be pooled and shared.

Clifton M. Howard
58 Van Orden Road
Harrington Park NJ 07640

The September 1979 issue of Personal Computing *contains a genealogy program—you might try that.—Editors.*

BOOK REVIEWS

Z-80 Assembly Language Programming
Lance Leventhal
Osborne & Associates, Inc.
Berkeley CA, 1979
Softcover, 606 pp., $9.50

I currently conduct a computer course using Leventhal's *8080A/8085 Assembly Language Programming* for teaching assembly language. So far it is the best 8080 book around. I have been doing Z-80 machine-language programming and have been looking for a comparable book for the Z-80. It was with real enthusiasm that I found my long-awaited copy of Lance Leventhal's *Z-80 Assembly Language Programming* in the mail. I have always found the Osborne and Associates books informative and well written, and Leventhal is a fine writer. In the proper context, this book is not a disappointment. The following review can only hit the high points.

This book is not for beginners. If you do not know what a bit, a byte, a program counter, a stack or an interrupt is, you will probably find this difficult or impossible reading. These topics are all covered either perfunctorily, by allusion or not at all. Leventhal's book is intended for readers at a more advanced level, such as those who have done at least some simple machine- or assembly-language programming.

The book begins with an explanation of assemblers. An introduction to the general features of the Z-80 instruction follows; I consider this the weakest portion of the book. Complete listings of the Z-80 instruction set, both by function and alphabetically, follow. The pictorial representation of the instructions used in other Osborne and Associates books is used in the *Z-80 Assembly Language Programming* alphabetical listing. The registers and memory locations affected are all shown. This approach is alien to those familiar with the Intel or Zilog format, but once you're used to it, it is a valuable reference and excellent alternate method of visualizing the instructions. A useful, complete comparison of the 8080 and Z-80 mnemonics is also given; there are just enough similarities and differences to be bothersome to the 8080 programmer.

Next comes what I consider the best part of the book, the programming examples. The examples are excellent for usefulness of subject matter, clearness of demonstration of concepts and development of programming style. One of the best ways to learn programming is to study good programs; these programs all deserve careful study. A few examples include: one's complement, masking, multibyte addition and subtraction, sum of squares and program loops.

Many of the programs presolve common problems and can be used as a valuable library. The organization of the examples is also excellent. Clean flowchart and

programming solutions are given. Frequently these are followed by an improved version that is either a logical extension of the previous one or that introduces and implements a clean, clever and general strategy (very often using a special Z-80 instruction). Sometimes even a third one is given. Finally, the author points out further approaches or asks questions concerning the advantages and disadvantages of the various approaches. Every chapter has good, frequently challenging problems, which should be worked through.

There is also a section on the use of the programmable Zilog parallel and serial interface adapter chips, but I think this will be particularly sticky going for software types or those without appreciable hardware experience.

Toward the end of the book are excellent discussions and examples of program definition and design and different programming strategies (i.e., top down, bottom up, modular, structured, etc.), and the advantages and disadvantages of them.

The book also contains a 30-page chapter on debugging programs. This includes several excellent examples of real programs with realistic errors and their resolution, a checklist of common errors, which should be posted over every computer, and a simple breakpoint and register dump routine. If newcomers do not have the latter register dump in their software, they should copy this one and use it as a debugging tool while working through the book.

My biggest complaint is that the binding appears to be the same as for other Osborne books—inferior. My Z-80 volume is held together with a rubber band. For a book that will get the very heavy use this will, the binding should be better.

Another weakness is the description of interrupts. If you do not understand 8080 interrupt structure in some detail, Leventhal's treatment will be hard going. Although Leventhal carefully points out many of the errors of interrupt routines, in the keyboard input routine of pages 12-17, he exits an interrupt service routine with a jump. This dangerous procedure leaves one return address on the stack and the stack pointer down by two. Leventhal knows what he is doing and should clear it before using the interrupt routine. Surprisingly, he completely fails to warn the reader of the insidious and deadly error.

On the whole, my complaints were few. I found the examples so clean, so instructive and so useful that I hated to see the book end. I would, with pleasure, pay more if this material were expanded.

If I taught a course using the Z-80, I would use the new Leventhal Z-80 book. The minor shortcomings, even for the beginner, are easily overcome in a teaching environment. In addition, Osborne and Associates is a first-class operation. The publication of this book was delayed, and they sent out a card, giving the new expected delivery date, which gave the purchaser a chance to request a full refund or wait. The book appeared promptly on the quoted date.

James Demas
Charlottesville VA

Basic Microprocessors and the 6800
Ron Bishop
Hayden Book Co., Inc.
Rochelle Park NJ
Softbound, 262 pp., $11.95

Ron Bishop, the author of *Basic Microprocessors and the 6800*, is the manager of technical training for the Motorola Semiconductor Group. Both his grasp of microprocessor fundamentals and his ability to put the subject across in an easily understandable manner are evident in this book, which is suitable for either classroom or individual usage.

The text assumes no previous reader knowledge, but it is written so that it can be used beneficially by both the beginning student and the one who has a little or a lot of digital background. It is easy to skim through until you run into something that isn't quite clear and then start studying from there.

For the person without any prior digital experience, the text starts by discussing basic electricity, logic gates, number systems and digital arithmetic. Next comes a chapter titled "Microcomputers—What are they?" This goes into a little computer history and then briefly describes the various components that make up a complete microcomputer system. These include RAM, ROM and interface adapters.

Chapter 6 is a discussion of programming concepts. Up to this point the instruction is general and could apply to any one of the many microprocessors that are available. Starting with chapter 7, Ron zeroes in on the 6800, and from there it is the focus of attention. He goes into the various addressing modes that the 6800 supports. Then each instruction is described thoroughly with examples of its use with the different addressing modes. Register status is shown before and after the execution of the instruction. It is easy to see exactly what each one does. A 6800 assembler is also discussed, and examples of source programs are listed.

For the hardware enthusiast, chapter 9 covers the 6800 family of microcomputer components, and chapter 10 describes their utilization. Pin-outs and requirements for the 6800, the 6810 RAM, the 6830 ROM, the 6821 peripheral interface adapter (PIA) and the 6850 asynchronous communications interface adapter (ACIA) are given. This is a detailed discussion, and it should be possible to build a complete microcomputer from scratch using the information in these two chapters.

Finally, the last chapter contains a series of example 6800 programs shown in both source and object form. Each program is explained, and hardware requirements for interface are included where necessary. The programs range from handling mathematical problems to controlling external processes.

Although *Basic Microprocessors and the 6800* is obviously intended to be used in a learning situation, I have also found it useful as a 6800 hardware and software reference book. Anyone who has or plans to buy a 6800-based microcomputer should definitely add this volume to his library.

Rod Hallen
Tombstone AZ

How to Start Your Own Systems House
Leslie Nelson
Essex Publishing
Caldwell NJ
1978, $36, Softbound

Numerous times, computerists are told that with minimal effort they can turn their hobby into a profit-making business. Exactly where does the computerist look for information about start-up procedures and other details in the computer business field?

Essex Publishing has an answer with their house computer compendium: *How to Start Your Own Systems House.* The introductory chapters of this book pertain to the computer industry as a whole. They outline, in general terms, the history and present status of the industry. From this point forward, the book goes into the nitty-gritty of the mechanics involved in starting a systems house. Specific statistics stating the number of systems houses by state, average sales dollars of these houses, average hardware expenditures and specific marketing strategy are given.

The threat of large corporations (for example, IBM, Texas Instruments) taking over the low-end small-business computer field is outlined with detailed analysis of the individual companies. General market strategy is described by comparing various manufacturers and the niche in which their equipment should be competitive. Hardware applications, with a view to systems-house purchasing, are given for several different systems applications.

Sample systems packages are referenced along with methodology of sales and differences among the various advertising media. The controversy about using direct salesmen as opposed to representatives is discussed in an unbiased and factual manner with an eye toward the economics of both. Product-pricing chapters include the areas of optimum pricing, recognition of the price ceiling and floor, bundled versus unbundled systems, lowballing and discounting.

Chapter 13 deals with the selling cycle and covers the entire period of the actual sale. This chapter also has examples of systems proposals, cash-flow analysis, typical systems requirements for programs, purchasing agreements, contracts for sale and terms of sale. Any effort of good salesmanship is devoted to negotiating and answering customer objections.

Chapter 15 offers typical objections (to purchases) that customers will bring up and provides fairly adequate answers for the salesman to use to counter these objections.

In the final chapters and the appendices, general business exigencies and considerations are detailed; the author provides practical answers to questions in these areas.

I have read many books that purportedly were "manuals" for the hobbyist starting a computer business. The majority of these have fallen short of their potential because details—the type that someone going into business needs—are discussed in generalities.

How to Start Your Own Sys-

tems House is definitely on a level above the rest. This book seems to be the real encyclopedia of the systems-house business. The only material that could be questioned is the use of the statistics because there is no explanation outlining their validity or collection criteria.

Another, somewhat minor, flaw deals with the packaging of the book itself. In view of the purchase price it would seem more appealing to the purchaser, I believe, to bind the book in a more dignified manner than using a metal fastener through punched holes in the pages.

All in all this book is decidedly worth the investment for the potential systems-house owner or the computer hobbyist who is interested in reading *exactly* what is involved in starting a business in the computer field.

James R. Fatz
Ft. Wood MO

How to Design and Build Your Own Custom TV Games
David L. Heiserman
TAB Books
Blue Ridge Summit PA, 1978
Softbound, 546 pp., $9.95

I am addicted to TV games, and every Friday after payday, I head for the local "pinball palace" and spend the evening racing dragsters, sinking submarines and battling space monsters. When I saw *How to Design and Build Your Own Custom TV Games* sitting on the shelf of a nearby bookstore, my first reaction was "Buy it!" I did, and I don't regret it.

This excellent book is loaded with information on building video games. It contains 12 chapters and two appendices. I do not recommend this book for beginners. To master the profuse amount of material covered, you should have a thorough knowledge of the *basic* elements of digital logic (i.e., gates, flip-flops, counters, multiplexers) because you will have to design your logic networks to create the games you want.

The book presents game design in a learn-by-doing fashion. First, the operation of a television set is discussed, followed by an explanation of the requirements for a basic video game. Then you build the "heart" of all video circuits—the horizontal and vertical sync controls. A fairly simple circuit must be built to use the other circuits in the book because all other circuits focus around it. The control circuit uses TTL integrated circuits and shouldn't cost more than $15 to build.

Once you have built the timing control circuit, you hook it up to your TV or monitor and begin experimenting with a handful of gates to create simple static figures such as lines, rectangles and checkerboards. The basic rules and guidelines for creating these images are explained in detail.

After you have mastered simple static figures, you start working with matrices to create more complex images: race cars, missiles, cowboys and clouds. Here things become tricky, so it's wise to take this chapter slowly and try every example the book shows so you will have a thorough understanding of the generation of complex figures. The reason for this is that the information learned here will be used in the latter part of the book. The circuits become increasingly complex but they are still fairly cheap to build since they use the more common TTL ICs.

Explanations of how to put your static figures in motion with both automatic and manual controls follow. A simple two-player game of "tag" is used as a design example.

When you are able to control your figures, you can add some useful game controls to provide for delayed start, reset and automatic stop. Other aspects of game control such as speed and figure-contact sensing are also explained. To assist the discussion, a missile attack game is described.

Next comes a collection of video game circuits ready to be built. Each game is explained in detail as to how it works and the problems encountered in its design. Each game uses the basic video timing circuits described in the first part of the book and represents no more than $20 worth of parts (again, all common TTL ICs). These games, however, are not of very high quality, and by the time you finish the book, you should be able to improve the games considerably using the circuits provided as the basic framework.

The latter half of the book deals with advanced TV game techniques. You are shown how to design scoring and timekeeping circuits for your game designs. Rebound effects for games such as tennis, soccer and pinball are thoroughly explained as you are taken through the design of a simple pinball game. Probably the most difficult chapter in the book discusses animation and rotation of complex figures for use in games like Tank. No TV game is complete without sound effects; this book shows you how to create them.

The book winds up with two appendices. Appendix I is a complete listing of the horizontal and vertical sync generator's binary outputs and provides quick reference to when the various parts of the composite video signal start and stop. Appendix II is a "minidata book" with pin-outs and truth tables for the more complicated TTL ICs used in the circuits, such as counters, flip-flops and comparators.

Overall, I was quite impressed with *Custom TV Games.* The material is clearly explained and easy to understand. However, this book can't be read overnight. To get the most from it, you must build the circuits in the examples as well as do a little experimenting of your own. If you get this book, get a protoboard too. It will make experimentation much easier.

This book is not without its faults, either. Schematics for an rf modulator are not provided (the book suggests you buy one). Nor is there any mention of color video games or computer control. Several places are unclear as to *why* you must do this in that particular manner. Apparently, the author considered the topic irrelevant or thought the reader could deduce the whys for himself. The operation of the sync generator circuit was particularly unclear.

Those contemplating building their own TVT or computer graphics system may also want to read this book. While the book does not even consider the possibility of computer interface, it contains a good deal of information that could be of value. When I first bought the book, I had no idea how TV games, much less graphics systems for computers, worked. After reading the book, I realize that many techniques employed readily lend themselves to computerization.

For example, to generate a race car in a TV game, you use a matrix generator circuit composed of a few gates and a multiplexer. I see no reason why this couldn't be replaced with a few bytes of memory in a computer and a suitable routine. This book explains what has to be done to create and animate images. Then it describes the necessary circuits to do the job. Instead of using circuits, you can use software. Owners of RCA 1802 systems with the 1861 video chip will find this book useful when developing their own games because they already have the capability to generate the proper video signals.

If you love TV games, this is the book for you. The material can be mastered in a few short weeks, and before you know it, you'll be designing your own arcade-quality games. I estimate that after you have built a TV game or two and played them 120 times, you will have saved enough quarters to pay for the book and the circuits!

Steve Dominguez
Golden CO

CONTEST!

"Best article" winner for August was Robert Edmonds, author of "Machine-Language Monitors for the TRS-80."

Winner of a book and a lifetime subscription were, respectively, Kirkor Sekercan of Baltimore MD, and Matt Robins of Studio City CA.

One of your responsibilites, as a reader of *Kilobaud MICROCOMPUTING*, is to aid and abet the increasing of circulation and advertising, both of which will bring you the same benefit: a larger and even better magazine. You can help by encouraging your friends to subscribe to *Kilobaud MICROCOMPUTING*. Remember: Subscriptions are guaranteed—money back if not delighted, so no one can lose. You can also help by tearing out one of the cards just inside the back cover and circling replies you'd like to see: catalogs, spec sheets, etc. Advertisers put a lot of trust in reader requests for information. To make it more worth your while to send in the card, a drawing will be held each month and the winner will get a lifetime subscription to *Kilobaud MICROCOMPUTING*!

YOUR NEXT COMPUTER

You know about computers. In fact, you probably own one now. One that you might be thinking of expanding. We have a better idea. Take a really giant step into the personal computing future with a C4P or C8P from Ohio Scientific. These two new premium computer systems offer the best specs in the personal computing industry with built-in performance levels that you could never achieve with your present system, even with all the add-ons available. We'll show you why.

THE FACTS

SPEED

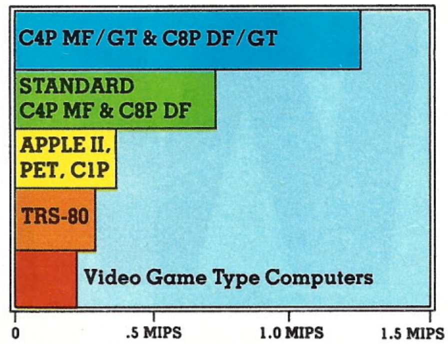
Speed separates the computers from the toys. The faster the processor executes instructions the more elaborate and greater the I/O can be. The C4P and C8P have execution speed that is twice as fast as Apple II, or Commodore PET and over THREE times as fast as TRS-80. They are many times faster than the recently introduced flock of video game type computers.

GT OPTION As if that weren't fast enough, the C4P and C8P's speed is nearly doubled when equipped with the Ohio Scientific GT option. By utilizing a 6502C microprocessor in conjunction with ultra-fast static memories, a C4P or C8P equipped with the GT option, will yield the following performance:

1.2 million instructions per second. Average.

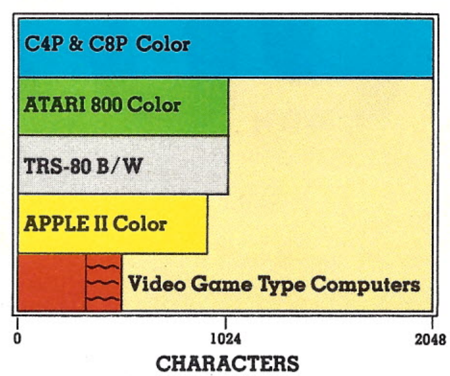
Memory to accumulator ADD time — 600NS.

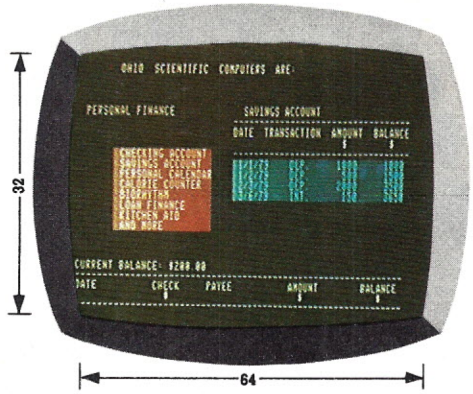
JUMP extended — 900NS.

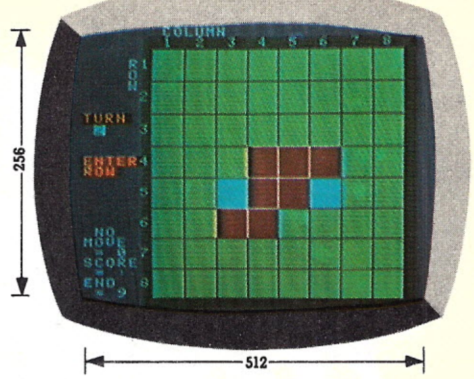


DISPLAY

The C4P and the C8P offer more display than other personal computers — 2048 characters — 32 rows of 64 columns with upper and lower case. Long display width makes user instruction easier to program and to read. The effective graphics resolution of 256 x 512 points allows these computers to match the display limit of even the best color television sets.







16 COLORS

The C4P and C8P offer a brilliant array of 16 colors including black available in both alphabetics and graphics.

CONSTRUCTION

The C4P incorporates a fully RF shielded aluminum case with 2-step baked on enamel finish. It is trimmed with solid oiled walnut and die-cast chromed dress panels. Compare its construction to the plastic cases that are standard on other personal computers.

The quality doesn't stop at the surface. The C4P and C8P are modular BUS orientated computers with 4 and 8 slots respectively. The internal electronics are built to rigorous industrial standards.

Modularity means expandability and obsolescence protection. In fact, the original 1977 vintage C2-4P can be upgraded to a C4P by changing PC cards at substantially less cost than purchasing a new computer.

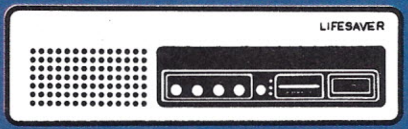
* Apple II, Commodore PET, TRS-80, and Atari 800 are registered trade names of Apple Computer Inc., Commodore Business Machines Ltd., Radio Shack, Atari, respectively.

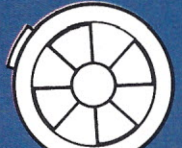
The C4P MF is shown with optional accessories (clockwise). Home Color TV set (requires RF modulator), 2 joy sticks, AC-Remote console and 2 modules, wireless smoke detector and window detector, modem, printer and wireless remote security console (on top of TV.)

JUST LOOK AT ALL THE I/O OF THE C4P MF — BUILT IN

INTERFACES

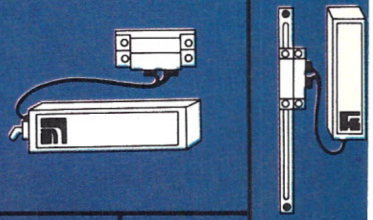
I/O capabilities. The most important feature to look for when you purchase your next computer. Compare these standard features of the C4P and C8P disk systems to any other computer system. Regardless of price, you'll find none that even come close.





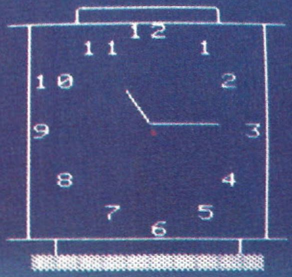
HOME SECURITY INTERFACES

1-home security interface with fire and intrusion detection



CONTROL INTERFACES

16 parallel I/O lines

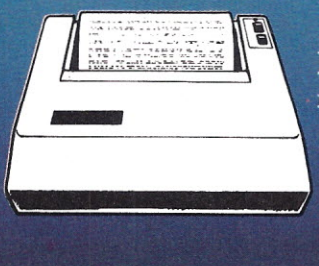


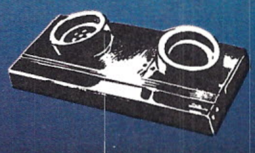
CLOCK

1-Real time clock and count down timer

RS — 232 PORTS

1-300 baud modem port
1-300/1200 baud printer port
Directly connect to an optional modem and printer





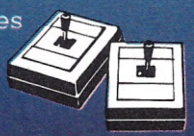
Only an Ohio Scientific C4P MF or C8P DF can offer you all this I/O.

AVAILABLE ON THE BACK AND READY TO RUN.

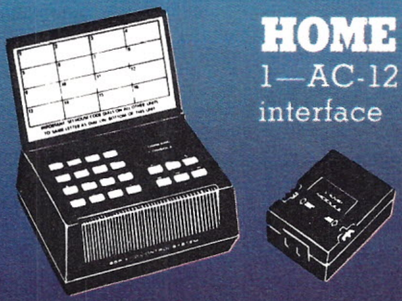
ACCESSORY BUS
One accessory BUS connector for an external 48 line I/O board, PROM blaster, analog data module or education board.

SOUND
1-programmable tone generator 200 — 20KHz
1-8 bit companding digital to analog converter (DAC) for music and voice output

HUMAN INPUT EXPANSION
2-8 axis joystick interfaces
2-10 keypad interfaces



HOME INTERFACES
1—AC-12 AC remote control interface



SOFTWARE

Ohio Scientific offers a full comprehensive library of both systems and applications software for the C4P and the C8P. And, because our main language is Microsoft BASIC like most other personal computers, much of your old software can be used on the C4P and C8P with little or no modification except for the special I/O functions and the much faster speed of your new computer. This would include software from the TRS-80 Level II, Apple floating point BASIC, Commodore BASIC and many others.

SYSTEMS INTEGRATION

There is a lot of software available for a lot of computers. Unfortunately for the user in almost every case the computer is available from one supplier, software is available from a dozen independent suppliers and accessory devices are available from yet other suppliers. Ohio Scientific has a different approach. We offer a comprehensive library of systems and applications software for the 4P and 8P. In fact, we offer more factory supported software than any other personal computer company. For example, say you have a brand X computer and you buy a real time clock from company Y which supplies software to use the clock. Then you buy an AC controller from company Z who also provides software. The system works fine as long as you want to monitor time or control AC devices but you are out of luck when you want to use the clock in conjunction with controlling AC devices. With Ohio Scientific's systems you can be monitoring home security, time, controlling AC devices and be playing an exciting video game, all at the same time because the systems software, the applications software, and the accessories *form an integrated package which works together without end user modification.*

FOREGROUND/ BACKGROUND OPERATION

This means that your computer can be engaging in home monitoring activities at the same time it is running other programs.

EXPANSION

As you can see, the C4P and C8P are truly exceptional premium computers with just their standard features alone. Above and beyond that they are easily expandable to add exciting advanced features like word processing, additional memory, voice I/O, and our new universal telephone interface (UTI).

C4P VS. C8P

The C4P is a 4-slot portable computer with one open slot for expansion. The C8P is an 8-slot mainframe class computer with five open slots. It features over 3 times the expansion capability of the C4P for advanced home, experimental and small business applications. The C8P's dual 8″ floppies store about 8 times the information of a single mini-floppy and access it many times faster.

ADVANCED FEATURES FOR C8P DF EXPANSION

Voice I/O

The C8P DF can be optionally equipped with a voice I/O system that includes a Votrax module capable of generating English speech phonetically. It also has provisions for a user populated 5-channel feature extractor for voice input experimentation.

Universal Telephone Interface (UTI)

Optionally equipped with a Universal Telephone Interface system, the C8P DF has the ability to dial any telephone number, utilizing rotary dial or touch tone telephone lines. It can respond to touch tone or modem signals and can route voice to tape recorders.

It can answer by touch tone, modem, stored message or Votrax voice output (when equipped with Votrax module or used in conjunction with a CA-14 Voice I/O.)

A C8P DF with UTI, voice output, AC-Remote, home security and its clock yield the home computer of the future with uncannily human-like capabilities to communicate via phone lines and operate and monitor typical home functions.

FINAL FACTS

Buying a new computer is a serious, long-term investment. So we invite you to shop around and compare. The closest thing you'll find to a C4P or C8P will cost twice as much and offer less than half the performance. We know. Because there's nothing like these exceptional premium computers at any price, anywhere. And probably won't be for a very long time.

*TRS-80 Level II, Apple floating point BASIC and Commodore BASIC are registered trade names of, Radio Shack, Apple Computer Inc., Commodore Business Machines Ltd., respectively.

SPECIFICATION CHART

FEATURE
Microprocessor type GT option 6502C
Full 53-key Keyboard
BASIC in ROM
BASIC on Disk
Minimal Config. RAM
Minimal Config. Total Memory RAM + Display + ROM
Maximum RAM
TV/Video Monitor
Cassette Recorder
Mini-Floppy Disk
Dual Mini-Floppy Disk
Dual 8″ Floppy Disk
Video Display
Color Graphics (up to 16 colors), Upper and Lower Case, Graphics + Gaming Elements
Effective Screen Resolution
Audio Output (200 to 20KHz)
DAC for Voice and Music Generation
Key Pad Interfaces
Joystick Interfaces
AC Remote Control Interface
Audio Cassette Interface
Real Time Clock
Home Security System Interface
Printer Interface
Modem Interface
16 Parallel Lines + Acc'y. BUS
GT Option
Winchester Hard Disks Option
Voice I/O
Telephone Interface

C4P	C4P MF	C8P	C8P DF
6502	6502A	6502	6502A
Yes	Yes	Yes	Yes
Yes	No	Yes	No
No	Yes	No	Yes
8K	24K	8K	32K
19.5K	27.5K	19.5K	35.5K
32K	48K	32K	48K
Acc'y.	Acc'y.	Acc'y.	Acc'y.
Acc'y.	No	Acc'y.	No
Acc'y.	Yes	No	No
Acc'y.	Acc'y.	No	No
No	No	Acc'y.	Yes
32 x 64	32 x 64	32 x 64	32 x 64
Yes	Yes	Yes	Yes
256 x 512	256 x 512	256 x 512	256 x 512
Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes
Yes	No	Yes	No
No	Yes	No	Yes
No	Yes	No	Yes
Yes*	Yes	Yes*	Yes
No	Yes	No	Yes
No	Yes	No	Yes
No	Acc'y.	No	Acc'y.
No	No	Acc'y.	Acc'y.
No	No	Acc'y.	Acc'y.
No	No	Acc'y.	Acc'y.

*Not wired to connector.

Computers come with keyboards and floppies where specified. Other equipment shown is optional.

HARDWARE

COMPUTERS

Model	Description	Price
C4P	8K BASIC in ROM, 8K RAM, Demo Cassette	**$ 698**
C4P MF	24K RAM, Single Mini-Floppy, OS-65D 3.1 operating system and 2 demo disks	**1,695**
C8P	8K BASIC in ROM, 8K RAM, Demo Cassette	**895**
C8P DF	32K RAM Dual 8″ floppies, OS-65D 3.1 and 2 demo disks.	**2,597**

ACCESSORIES

C4P	C4P MF	C8P	C8P DF	Model	Description	Price
●	●	●	●	**AC-3P**	12″ B/W Combination Monitor/TV	**$ 115**
●	●	●	●	**AC-15P**	12″ Color Monitor	**399**
●	●	●	●	**AC-16P**	2—8 Axis Joy sticks with cables	**39**
	●		●	**AC-11P**	Answer/Originate 300 baud modem with cable	**199**
●	●	●	●	**AC-12P**	AC-Remote starter set, console, 2 lamp modules, 2 appliance modules, OS-65D home control operating system.	**175**
	●		●	**AC-17P**	Home security starter set (wireless), console, 1 fire detector 2-window units, one door unit and Demonstration software.	**249**
		●	●	**CA-15**	Universal telephone interface with touch tone encoder / decoder, 300 baud orginate / answer modem, analog signal mux / demux.	**499**
		●	●	**CA-15V**	As above with Votrax voice module for computer generated voice response.	**799**

PRINTERS

C4P	C4P MF	C8P	C8P DF	Model	Description	Price
●	●	●	●	**AC-18P**	Low cost high speed 8½″ aluminized paper printer with upper/lower case.	**$ 695**
		●	●	**AC-9TP**	Centronics 779 110 cps tractor feed Business printer with interface.	**1,250**
	●	●	●	**AC-14**	NEC Spinwriter—word processing printer with high speed parallel Interface.	**2,795**

GT OPTIONS (must be purchased with computer)

C4P	C4P MF	C8P	C8P DF	Model	Description	Price
	●			**C4P MF/GT**	24K, 120NS Memory, 6502C processor, 2-speed clock.	add **$ 950**
			●	**C8P DF/GT**	48K, 120NS Memory, 6502C processor, 2 speed clock.	add **1,825**

For other expansion accessories such as add-on memory, additional floppy drives and other accessory boards consult the current full line price list.

SOFTWARE

Here is a partial listing of diskettes for the C4P and C8P. For a complete listing of diskettes and cassettes consult the current full line price list.

APPLICATIONS SOFTWARE

Game Disk 1	Arcade games	**$ 29**
Game Disk 2	Arcade games	**29**
Game Disk 3	Popular Conventional Computer games	**29**
Game Disk 4	Popular Conventional Computer games	**29**
Game Disk 5	Advanced Arcade games	**29**
Game Disk 6	Advanced Arcade games	**29**
Game Disk 7	Joy stick Arcade games	**29**
Game Disk 8	Animations and Cartoons (2 disk set)	**29**
Personal Disk 1	Checking/Savings/Loans/Etc.	**29**
Personal Disk 2	More personal programs	**29**
Education Disk 1	Educational games	**29**
Education Disk 2	BASIC tutor series	**29**
Education Disk 3	Tests/tutors/drills	**29**

BUSINESS SOFTWARE

Business Disk 1	Depreciation/return on investments etc....	**$ 29**
Business Disk 2	Mailing list/Address list/etc....	**29**
OS-WP2	Complete word processing system	**200**
OS-MDMS	65D based Data Base Manager and information management system. A must for business use.	**49**
MDMS-A/R	Accounts Receivable System	**29**
MDMS-A/P	Accounts Payable System	**29**
MDMS-Inventory	Inventory System	**29**
MDMS-Aux. 1	Sort/File packer/key File editor for ISAM	**29**

UTILITIES

65D Aux. 1	Sort/packer/memory test/ disassembler	**$ 29**
Graphics 1	Color graphics utilities with high resolution plot package	**29**
Home Control 2	Advanced home control program using AC-12 and AC-17	**29**
DAC Routines 1	Music composition system with chord generation capability	**39**

Purchase your C4P or C8P and accessories direct from your local Ohio Scientific dealer. Over 300 dealers nationwide.

OHIO SCIENTIFIC

1333 S. Chillicothe Road • Aurora, Ohio 44202 • (216) 562-3101

LETTERS TO THE EDITOR

Convert

As a longtime subscriber to your sister publication, *73*, I became perturbed at the I/O articles appearing in *73* and wrote a letter stating, "I subscribed to an amateur radio magazine not a computer publication. Please cancel my subscription."

Well, after talking to Wayne at a Dayton hamfest, I decided *73* wasn't so bad after all, and I canceled my cancellation.

Now comes the payoff! I recently bought a Radio Shack TRS-80 and am having a ball with it! I have enrolled in a Radio Shack TRS-80 computer course (starting with Level I) and plan to go through the Level II, and other, courses.

To put the frosting on it all, I am now a subscriber to *Microcomputing*! Please forward one pound of crow for me to eat.

But lest you think I'm going to let you off the hook; I just received my September issue of *K/M* and read of your interest in TRS-80 articles. As a retired radio/TV/advertising writer, may I point out your TRS-80 item's run-over to pages 22-23, in which you wrote, "We have people what can spell and correct you're grammar." Please tell me that your spelling "you're" was either a gag or a typo!

PS. I am a professional, legit radio/TV, film actor, too, and have referred to Peterborough 5000 times as the stage manager in Thornton Wilder's *Our Town*.

Al Henderson
WD8OGP

It were a gag.—Editors.

Détente

Several articles have been written on an interface between a variety of computers and printers . . . but unfortunately, none about the TRS-80 and Heathkit H14, which was my selection. I assumed the DECwriter BASIC program as listed in Radio Shack's 232C manual would do the trick, but handshaking as described does not exist. I made many calls to both Radio Shack and Heathkit technical centers with futilitarian results.

After reading a letter from Glen Jenkins in the August '79 Computer Clinic (p. 16) inquiring about a parallel interface, I realized I was not the only soul with this combination. My many thanks to Glen Jenkins for shedding some light on this problem.

I am now a very contented novice operating my Heathkit H14 printer at a loafing 4800 baud, handshaking its DTR and RTS leads with my TRS-80 POKEing at −256 (FF00). Those extra controls such as 96 characters per line, form feed, etc., were too simple. I just couldn't see the desert for the dunes.

In this world of computer chaos, it is reassuring to see two enemies work in harmony. It is also reassuring that *Kilobaud Microcomputing* made it possible.

Royal Scott
Dallas TX

Likes Larks

We would like to relate to you and your readers our dealings with one of your advertisers that warrants extra praise. We placed an order with Larks Electronics & Data (page 144 of September 1979 issue) for one of their Accelewriters for installation in our DECwriter. After installation, the unit failed and resulted in a repair bill at a local computer shop. After we contacted Larks, they agreed that the problem was a direct result of a wrong chip being sent in the kit and included a check for half of the repair bill as well as a conversion kit, at no charge, to convert the DECwriter back to 300 baud operation. We feel they have proved they are truly interested in their customers' satisfaction and do not hesitate in recommending the Accelewriter to our clients or other interested individuals.

Charles K. Ballinger, V.P.
ACIA, Inc.
Spokane WA

Re-Mits

OK. Now you guys have gone too far. Let me explain my meaning here.

January. We see a new, renovated cover, with an ad-type photo on the cover. Plus, surprise! A strange little "microcomputing" word below the familiar Kilobaud.

February. What next? Microcomputing expands to outshine our loved Kilobaud title. What's happening here? Well, at least the inside's not been mutilated, and we still have the table of contents on the cover.

March. Kilobaud shrinks, and Microcomputing becomes MICROCOMPUTING. Oh well, I can stand that. Even though the name Microcomputing leaves a lot to be desired, Kilobaud MICROCOMPUTING looks pretty nice.

April. MICROCOMPUTING is expanded, but (thankfully) Kilobaud is still the same minute size.

May. No change. Are they finally settling down? Unfortunately, no.

June. What? Kilobaud is reduced to microscopic print in the upper left-hand corner, and the name MICROCOMPUTING spreads out over the whole line. And more! The words "for business, education, FUN!" appear. Whew!

July. No change! Have they finally stopped changing. Well. . . .

August. Now we use black and gray on the cover. OK, guys, what's going on?

September. Now you've gone beyond my threshold of tolerance. The improvement upon the looks of the magazine has finally failed to outweigh the changes. Not only are we now using *green printing on yellow*, but—what's this? —"Complete contents on page 4."Aha! Now we phase out the table of contents on the cover! Instead of simply looking on the cover to see if an article is in an issue, I have to resort to the "traditional" method of opening up each magazine, flipping through the first few pages and searching down a column for an article I saw mentioned a few issues ago. Making the table of contents smaller was, in my opinion, an improvement. That just makes article hunting faster. Now you've nullified this with the inside-the-mag table of contents. What's this I see? "Plus diagnostic aids, computer blackjack and *much more*." Resorting to the "much more" tactic, eh?

Look, you guys. If you plan on phasing out the Kilobaud title altogether, you are making a big mistake. That's a distinctive title, as is Byte. "Microcomputing" puts your title in the class of Personal Computing, Interface Age, etc., but, to tell you the truth, it is even worse. The title Kilobaud is better by orders of magnitude. I suggest that readers of this magazine should write in to prevent the total elimination of Kilobaud from the title. (By the way, I wrote a letter to you referring to the magazine as Kilobaud, and you changed it to Microcomputing. So, I will spell it out. K-I-L-O-B-A-U-D is orders of magnitude a greater title than Microcomputing.) And I hereby register my vote to keep the contents list on the cover.

I think your magazine is very good (but what happened to PET-pourri in the September issue? I was waiting for that disk drive review). However, Kilobaud was just a bit better.

Mits Hadeishi (again)
Gardena CA
(Close to Los Angeles)

Bibliophile

Congratulations on an excellent publication. I have an idea to increase its circulation.

Have you ever considered asking the manufacturers' association (or some similar computer-oriented group) to *pay* to have a copy in every library? (Libraries like freebies, especially good ones.)

It would be a convincing argument. Do you know how many people go to libraries? How much traffic they get? How many *new* customers could be generated (as well as friendly old ones)?

Robin L. Salmansohn
Abington PA

What do you manufacturers and librarians think of that?—Editors.

Microcomputer Issue

We aren't having technological revolutions so much as technological tidal waves. Swept over time and again by rushes of science that change our culture to its roots, we no sooner catch a breath than here comes another! That Chinese curse—may you live in exciting times—states the predica-

ment. These are the most exciting times in history, and we have opportunity, exhilaration, confusion and anxiety as never before!

Microcomputers are the stuff of a new wave just beginning to swell, soon to crest and rush over society. As an editor, I want to work to reduce the confusion and anxiety and maximize the opportunity and exhilaration, and I am committing *Sociological Methods & Research* to deal with a special set of microcomputer implications.

An issue titled "Microcomputers in Social Science" will be published at the beginning of 1981 with articles on the following topics.

- Current microcomputer technology and available systems.
- Communications: word processing, voice synthesis, information networks.
- Personal computing for social, political and economic understanding.
- Microcomputers in survey research and polling.
- Microcomputers in laboratory research.
- Microcomputers in anthropological field studies.
- Microcomputers and education in classrooms and in homes.
- Statistical analysis on microcomputers.
- Microcomputers and simulations.
- Hardware and firmware to be expected by 1990 and 2000.

To make the issue readable, authoritative and useful, I must reach the people who read your magazine. So I am asking this favor of you. Would you please announce the special issue of *SMR* in your pages, mentioning the topics listed above and the deadline for manuscripts, August 1980. *SMR* is a refereed journal, so no article can be commissioned, and authors do not receive payment for their contributions. But if a manuscript is accepted, the author will have the satisfaction of publishing in a research journal on a topic of major social importance.

David R. Heise, PhD
Dept. of Sociology
University of NC
Chapel Hill NC 27514

BASIC Baedeker

The letter from Dr. V. A. Lewis in the September 1979 issue of your publication has prompted me to write and let you know that a very good guide to several dialects of BASIC is available. It is the Conduit BASIC Guide, 1979. Conduit is a nonprofit organization devoted to preparing transferable CAI material for colleges and universities. Their BASIC Guide contains a comparison chart of 20 versions of BASIC, including AppleSoft, PET, PolyMorphic, TRS-80 Level II, Dartmouth 1973, as well as some mainframe and mini BASICs. Conduit also publishes an author's guide. The address is:

Conduit
PO Box 388
Iowa City IA 52240

P. K. Wong
E. Lansing MI

Getting Haiku

Thanks to you and John Krutch of Sepulveda CA for the article on the Haiku composer (August 1979, p. 80). It was extremely refreshing to find a note of culture packed in with the PULL As and PUSH Bs. I wish I knew enough about the ceramic arts to paint and fire the pictures to go with some of the word images that pour out of my box of (apparently thinking) ICs.

Even though the published program in no way was compatible with my system, the article was inspiring enough to cause me to pause a while and write a program of my own that was just for fun and relaxation.

John P. Tucker
Laredo TX

Circuits and programs; world of homogenized milk; cream comes to the top.—Poetry editors.

New Documentation

I enjoyed Tim Ahrens' TVBUG article in the June 1979 issue (p. 48) and have just completed building the kit. The published article on the TVBUG is almost an exact copy of the information supplied by Motorola, which is understandable since Tim Ahrens and Dave Williamson prepared the technical information supplied with the TVBUG kit.

The schematic/parts list doesn't match that given in the June article; the primary change is the use of the 6848 ROM I/O timer to control the various alphanumeric and graphic modes in the 6847 VDG. The circuit as published shows all of the control lines grounded.

The primary problem I experienced with the TVBUG kit was due to an error in the documentation supplied with the kit, which failed to indicate that U57 and U59 (2114 RAMs) were required for minimal system operation.

I would be interested in corresponding with any other *Microcomputing* readers who would like to share information on the TVBUG system.

Tom J. Harmon
1505 Magnolia Dr.
Salisbury MD 21801

The documentation has improved greatly over the early kits—the photocopies have been replaced by a typeset document with full schematic. A "users' manual" has been written, and copies are sent to everyone who buys the kit and sends in the coupon provided. When this book has been typeset and bound, it will replace the current document now being enclosed with the kit.—Tim Ahrens.

Threat Pays Off

About a year ago I sent you a letter threatening not to renew my subscription to *Kilobaud* if you didn't carry more articles about OSI computers. I just mailed my check for renewal. Thanks for the articles!

E. Morris
Midland MI

Second Thoughts

I have been following Peter Stark's articles (up to and including the one in the July issue) about the SWTP 6800 system with great interest, since I own such a system. Upon rereading his June article I started to have some doubts, however, because Peter obviously did not try out all his suggestions in hardware. He suggests that connecting pins 27 and 36 of the AY-5-2376 keyboard encoder chip will provide the at-sign and the backslash. He probably looked at the coding table for the AY-5-2376 and mistook the reverse apostrophe for the backslash because it is the reverse apostrophe that comes out. I know because I had already installed the change to use with the TSC text processor (and a connected IBM Selectric). The apostrophe is used to indicate single capital. I use the reverse apostrophe instead of the backslash, which TSC uses, as the escape character in text strings (change locations 079C/D to CMPA #$60 in TSC's text processor). I hope Peter's other suggestions do have a hard background.

Hens Kolff
Berkel en Rodenrijs
Holland

Hens is right. I got my info from the encoder table on page 36 of Don Lancaster's TV Typewriter Cookbook, *which happens to have a misprint!—Pete Stark.*

The Proof's in the Coding

Since becoming a subscriber to *Microcomputing* I have found it to be an invaluable aid in the writing of sophisticated programs for my TRS-80. In several instances recently, the exact solution to a particular problem has appeared in *Microcomputing* while I was attempting a solution.

Incidentally, a good deal of credit goes to your proofreaders. All—repeat—all the errors were in my reading. Not a single error was found in the published code.

Wesley J. Haywood
Harvard MA

Good Things Come in Good Packages

I must commend you because your publication consistently arrives in the best condition of the several different magazines I receive each month. Please continue the good packaging and excellent contents.

Darren Toop
Nepean, Ontario Canada

You're lucky!—Wayne.

Fisher on Chess

The five moves required to beat Microchess 1.5 by Peter Jennings—and also sold by Radio Shack—are:

E2-E4
D1-F3
F1-C4
C4-D5
F3-F7

Checkmate. You win!

Ted Fisher
Danville IL

EXATRON STRINGY FLOPPY
Owners Association Newsletter

Secretary, Fred Waters

ESF FOR THE S-100 BUS

As regular readers know, the daddy of all the current versions of the Stringy Floppy is the one for the S-100 Bus. It was introduced at the Exatron booth in the 2d West Coast Computer Faire in San Jose in March, 1978. It met with great success, particularly among the engineers and programmers here in Silicon Valley. As the first model of the ESF, it has the advantage of extensive system software.

The S-100 ESF has recently gone through a period of extensive product improvement. It now has additional features, and upgrades on features already present. By software command you can now put the drive in fast-forward mode, to reduce the cycle time for the continuous-loop tape. Also by software command you can switch to the double-density mode, thereby doubling both the wafer capacity and the read/write rate. Double-density gives you 8K bytes on each five feet of tape, and with a five-foot wafer you can SAVE or LOAD the 8K in 6 seconds–that is, once around the continuous loop. This is a rate of 1600 bytes per second, or 14,400 baud. Quite a benefit when compared to the 300 baud of the standard cassette machine!

ESF S-100 SOFTWARE

On the conference table where ESFOA meets every Saturday, there is a volume entitled "Catalog of Software For Use With the Exatron Stringy Floppy". Listed inside is program material written by ESF owners mostly here in Silicon Valley, with a few from elsewhere in the U.S. Charlie Pack, whose picture you see above, is one of the most prolific contributors. He wrote the 1K Utility Program, and the 2K ESFMON, in two parts. The Stand-Alone Monitor has commands to DISPLAY memory, FILL memory with a selected code, JUMP to a chosen address, TRANSFER a block from one location to another, VERIFY one block against another, display and MODIFY memory, SEARCH memory for one or two selected bytes, and QUIT the monitor to go to a different program. The Tape Monitor has the following functions: display a CATALOG of all files and parameters on a tape wafer, CERTIFY a new wafer for reliability, SAVE a block of memory on tape, with or without AUTOSTART, GET a file from tape into memory, with or without immediate EXECUTE, VERIFY memory against a tape file, and WIND tape back to the start.

Charlie has also written a very compact Relocating Loader, and a number of other pieces of software for ESFOA, and is still at it.

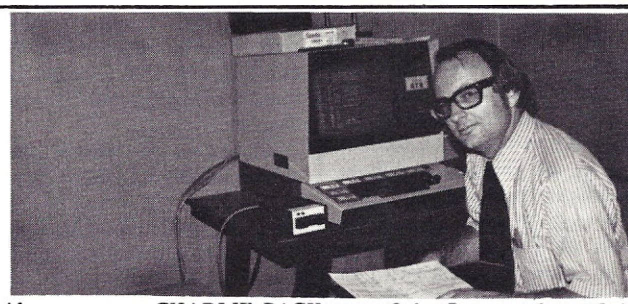
One more thing: the ESFOA software is backed up by superb documentation. This covers source code organization and comments, users manuals, and programming guides. Internal subroutines are handy for you to use in your own programs. Call or write for more information on the S-100 ESF and its software and documentation.

PURPOSE OF ESFOA

The generation of the software described above is the best example we can think of to show that the Exatron Stringy Floppy Owners Association works. With some pride we quote one sentence from the first-of-all ESFOA Newsletter, published in January 1978, some 21 months ago: "The purpose of ESFOA is the interchange of ideas, information, software, and firmware for the ESF, to the mutual advantage and benefit of all users." And to bring this up-to-date, within a few weeks of the introduction of the ESF for the TRS-80 to the market, new owners were showing up at the weekly workshop in Santa Clara to demonstrate programs they had written for this new version, and letters were coming in from all over the U.S. telling us of other such activity.

ESF FOR THE SS-50 BUS

We told you above about the first version of the ESF–the one for the S-100 bus. Jim Maynard in far-off Oklahoma heard about it, and decided he wanted one for his SWTP microcomputer–the SS-50 bus for the 6800 or 6809 microprocessor. So with some help by mail and by telephone, he came up with a working prototype. By the time he first showed up in Silicon Valley–the first time we laid eyes on him–his SWTP system with Stringy Floppy was up and running, and the result is the current ESF for the SWTP. If you're interested in this version, be sure you have read the ESFOA Newsletter in the October issue of **Microcomputing.**



Above you see CHARLIE PACK, one of the first members of the ESF Owners Association, at home writing more fine software using his microcomputer system. He is a professional programmer and microcomputer enthusiast, who developed HOCUS, his first general-purpose monitor for small systems, in 1976. He first saw the Stringy Floppy demonstrated at the 2d West Coast Computer Faire in San Jose in March 1978. He quickly got involved, and ended up doing a highly professional job of rewriting the utility program, and then writing ESFMON, a combination of a stand-alone monitor and complete operating routines for the Stringy Floppy. He has been contributing quality software ever since, some of which is described in the Newsletter below.

TRS-80 VERSION

During the development or improvement of other versions of the ESF, it soon became evident that an ESF for the TRS-80 was inevitable. Nowhere else were the disadvantages of audio cassette standards and techniques so manifest. And the TRS-80 had some characteristics that are remarkably well matched to those of the ESF. Most important is that both computer system and storage subsystem are ready-to-run when you turn them on; that both are suitable for use by those without any programming experience or technical knowledge; and that both work every time you operate them–no frustrating repeats because of low reliability. Once again the software concept and ultimately the program for the ESF were developed by an enthusiastic professional, a member of the Owners Association, and a brilliant but modest man who is therefore anonymous. The result was the introduction of the ESF for the TRS-80 at the 4th West Coast Computer Faire in May 1979, and its subsequent success and acclaim. Software and hardware now support multiple drives, machine language programs, data files and chained BASIC programs. Call us on the Hot Line for a complete information package.

HOW TO ORDER

All versions of the Exatron Stringy Floppy are covered by a 30-day moneyback guarantee and a 1-year warranty. The ESF is shipped from the factory assembled and tested. Exatron Stringy Floppies are normally "on the shelf" ready to ship. Credit card or COD orders can be placed by telephone to insure the fastest delivery.

User's Manuals for all versions of the ESF and a complete information package is available at no charge.

Base price for the S-100 ESF: \$289.50. For the TRS-80 ESF: \$249.50. For the SWTP ESF: \$250.00.

If you have any questions about these products, about Exatron, or about ESFOA, call the Hot Line. Address letters to ESFOA, 3559 Ryder St., Santa Clara, CA 95051.

HOT LINE 800-538-8559

WITHIN CA 408-737-7111

NEW PRODUCTS

Edited by Dennis Brisson

Heath's New Terminal

The H19 terminal for the H8 and H11 computers has greatly expanded the capabilities of the H9 terminal. I don't know about your H9, but ours has been a constant source of irritation due to intermittent operation.

It took 17 hours to build the H19, do preliminary tests, do video alignment, hook up to the H8 and have a prerecorded program running. The H8 I/O board was still set at 600 baud, and everything worked OK. The display contains 24 lines of 80 characters each (twice the lines of the H9). The display is very solid, and scrolling is consistent, showing definite design improvements over the H9.

The terminal was running so well at 600 baud that I jumpered the I/O for 9600 baud in the H8. A simple flick of a DIP switch set the H19 to 9600 baud. The difference was tremendous. The H19 is just as solid at 9600 as it is at 600 baud, and the operator has become the slowest member in the link. The H19 looks, acts and feels like a professional terminal. The keyboard and keypad are totally different from those on the H9. I strongly recommend the H19 to the serious computer hobbyist or business user.

Some of the features of the H19 are:

Programmable—cursor controls and positioning, cursor position report, reverse video (white background), reverse scrolling, screen hold with manual scroll, erasing (top, bottom, line or PAGE), 25th line (normally hidden), key click (a short beep on each keystroke), block or underline cursor or no cursor at all, keypad shifted, auto line feed/carriage return or carriage return and auto line feed, ANSI or Heath format, baud rate and graphics characters.

Manual—back space, delete (rubout on H9), tab (fixed at 9, 17, 25, 33, 41, 49, 57, 65 and 73) (also programmable), caps lock (locks letters only into uppercase), offline, break and reset.

When I first tried to use the graphic mode, I ran into trouble. I could use only the graphic functions controlled by uppercase. All our BASICs were configured in uppercase. The first BASIC I tackled was disk E.B.H. BASIC 110.00.00. Hidden in paragraph 2, pages 1-55, are the instructions for lowercase: Set TT: NOMLI and set TT: NOMLO. After making these changes in the disk, I was able to use the graphics of the H19.

The next BASIC was E.B.H. BASIC 10.01.02, which came with the H8 (which now has 56K of RAM memory). I kept getting memory errors. If you have this version, you will have to set high memory to 49145 maximum, not the 65535 you're allowed with 56K of RAM. Set lowercase by typing YES, and you are ready to use the H19. With E.B.H. BASIC 10:05 and the lowercase option, you can use the entire 56K of RAM, as well as the graphics.

In summary, the H19 is a professional-quality terminal, with features not found on many other, more costly, terminals. It is priced for the computer hobbyist ($675, kit) and is an excellent addition to any system with the RS-232 I/O port.

Heath Company, Benton Harbor MI 49022. Reader Service number H5.

Edward E. Umlor
Technical Dept., ISI

17.3 Mbyte Cartridge

The Model 640 cartridge transport employs a recording density of 6400 bits-per-inch to give a maximum unformatted storage capacity of 17.3 Mbytes. The transport, an ideal backup storage for the new 8 inch disk drives, has four-track read-after-write heads and uses 3M-type DC300 cartridges. Data transfer rate is 192 kHz utilizing a modified frequency modulation recording mode.

To reduce time-consuming rewind operations, the transport uses a serpentine technique in which adjacent tracks are recorded in opposite directions. Recording speed is 30 inches per second, while rewind and search speed is 90 ips. Start/stop time is 25 ms at 30 ips, 75 ms at 90 ips. Displacement is 0.375 inches and 3.38 inches at 30 ips and 90 ips, respectively. Instantaneous speed variation is ±3 percent, with a long-term variation of ±2 percent.

A three-point suspension system eliminates cartridge warping and increases tape life. A mechanical interlock prevents the cartridge from inadvertently disengaging; a position latch must be activated to remove the cartridge.

An infrared LED/phototransistor combination detects beginning of tape (BOT), load point (LP) and the end of tape (EOT). Extremely tolerant of ambient light, the ir combination prevents erroneous missed-hole detection and the resulting "tape munching." An integral tape cleaner removes dust during write, read, search and rewind operations; tape life is in excess of 20,000 passes. The lightweight (3.75 lbs., 4.5 × 6.5 × 8.36 inches) Model 640 employs a low-power servomotor. Power consumption is 10 W during read or write, 4 W when idle. Voltage requirements are +5 V dc regulated to ±5 percent and +24 V dc unregulated. Price is $900 in OEM quantities.

Kennedy Company, 540 West Woodbury Rd., Altadena CA 91001. Reader Service number K18.

Mailing List System

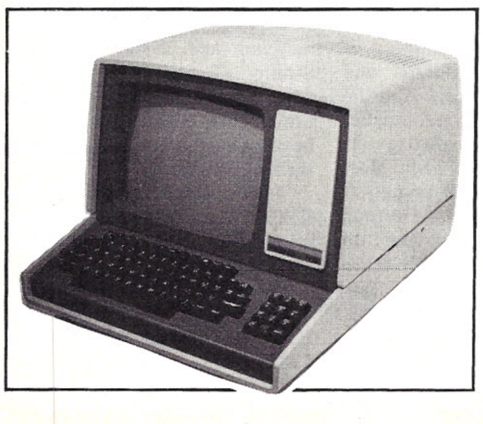
MAIL-V, an advanced mailing list system, includes a report writer, which allows you to specify the report or label formats on-line. Selection criteria, field calculations and multiple-sort keys are supported. One or more labels across a line can be selected. Fields include new zip-code extensions, last reference date and remark field. A selection code ranging from 0 to 32,000 is used to classify labels.

As opposed to most similar programs, MAIL-V does not require sorting the entire data base every time you add records; you can use the entire diskette for storing data, so sorting the entire file takes minutes instead of hours. It includes an advanced sorting algorithm and a separate module to handle sorting numeric zip codes. Any fields can be sorted or searched. TRS-80 DOS and 32K are required. Price is $59 for the diskette.

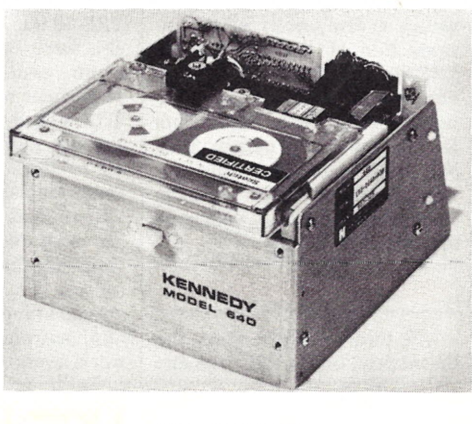
Micro Architect, 96 Dothan St., Arlington MA 02174. Reader Service number M89.

TEI Business System

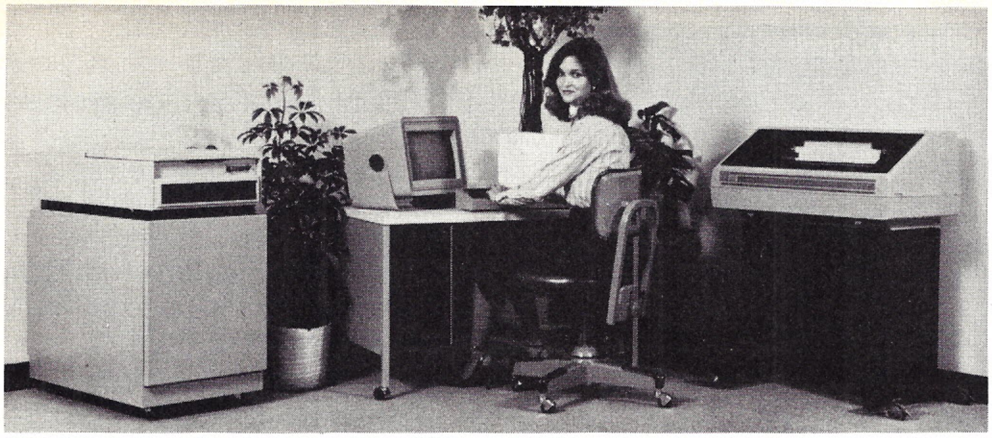
The 3400 Business Computer System has the fastest 8-bit processor (5 MHz) on the market today. Featuring an independent keyboard, work station, floppy or hard disk storage and modular construction, the 3400 System is flexibly designed to meet the



The H19.



The Model 640.



TEI's 3400 Business Computer System.

specific needs of each business. Also available with the 3400 system is a true multiuser, multi-tasking and multi-processing capability.

A new Business Information Management System, specifically designed for small- and medium-size businesses, is also available. The package includes General Ledger, Order Entry, Accounts Receivable, Accounts Payable and Invoicing.

TEI, Inc., 5075 S. Loop East, Houston TX 77033. Reader Service number T22.

Multi-Terminal Word Processor

STYLUS, a word-processing system from Educational Data Systems, 1682 Langley Ave., Irvine CA 92714, simplifies many of the repetitive and time-consuming tasks of daily business. Contracts, form letters and other documents can be individualized, modified or totally reformatted with a minimum of time and effort. STYLUS is a complete shared-logic, multi-terminal interactive word-processing system that can be added to any computer using the IRIS operating system. It can be combined with accounting software such as EDS's management, accounting and control system (MACS), thus providing both functions from a single minicomputer system.

Utilizing the inherent power of the IRIS file structures, STYLUS easily handles the storage, indexing, retrieval and manipulation of large amounts of text and data. Editing is accomplished on the CRT screen and viewed prior to hard-copy printout.

STYLUS features include: true proportional spacing, left and right justification, margin manipulation, automatic centering, tabbing and decimal tabbing, automatic indexing, search and replace (automatic substitution of words and phrases), automatic letter addressing, automatic underlining and automatic repagination. Price is $4000. Reader Service number E51.

PET Hard-copy Graphics

Now you can have full graphics capability for Houston Instrument's HIPLOT plotter with the Plotter program from West Coast Consultants, 1775 Lincoln Blvd., Tracy CA 95376. The program is available on cassette tape for the PET computer and drives the plotter through an RS-232 interface. The program is written in BASIC and offers sophisticated plot control to the user by means of several subroutines. The minimum memory requirements are 16K bytes. Price is $50. Reader Service number W34.

Non-Interface Video Printer

The EX-850 video printer reproduces any monotone graphic or alphanumeric display in any language and character font without hardware or software interface to the CRT. The EX-850 uses a unique video controller that connects directly to the video signal of any raster-scan CRT display and samples information on the screen at high speed. Using this technique, the EX-850 dispenses with the need for conventional interfacing and standard codes. If it's on the screen, the EX-850 will print it.

Visual information is quickly and quietly reproduced by a special 24-wire matrix printhead with overlapping print wires that yields permanent reproductions on inexpensive electrosensitive paper. The EX-850 will accept any standard video input (composite or separate video and sync) from the user's CRT terminal, TV, video monitor or computer. Front-panel controls select normal or high resolution and positive or negative image. Print operation is initiated either by a front-panel button or an external command. The $1250 price includes case, power supply, video printer controller, low paper detector, bell and paper roll holder.

Axiom Corporation, 5932 San Fernando Rd., Glendale CA 91202. Reader Service number A110.

TRS-80 Mass Storage Booklet

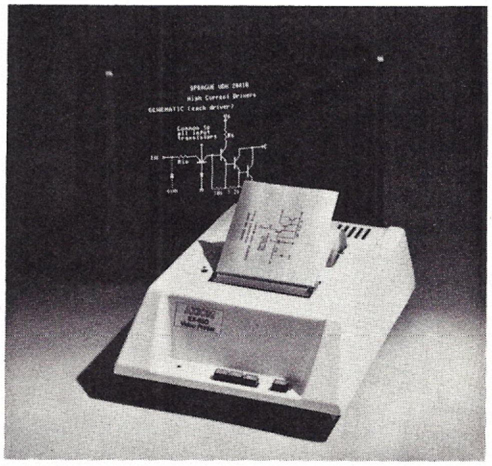
"Mass Storage Systems for the TRS-80" is a recently released booklet that outlines the various methods by which the TRS-80 user can load and store his programs off-line. The booklet describes cassette systems, mini-floppy disk systems, full-size floppy disk systems, data cartridge, high-speed cassette and proposed hard-disk systems. The relative advantages and disadvantages of each system are discussed in detail. Aspects of compatibility, software availability, cost, ease of operation, future advantages, reliability and versatility are examined.

Copies of the booklet are obtainable at no charge from Parasitic Engineering, Box 6314, Albany CA 94706. Reader Service number P63.

Disk System

The HDS-4000 Disk System, with a 13.7 or 27.4 megabyte capacity, includes a Shugart fixed-media disk drive, the Digital Microsystems intelligent controller with error correction and up to 32K buffering, cabinet,

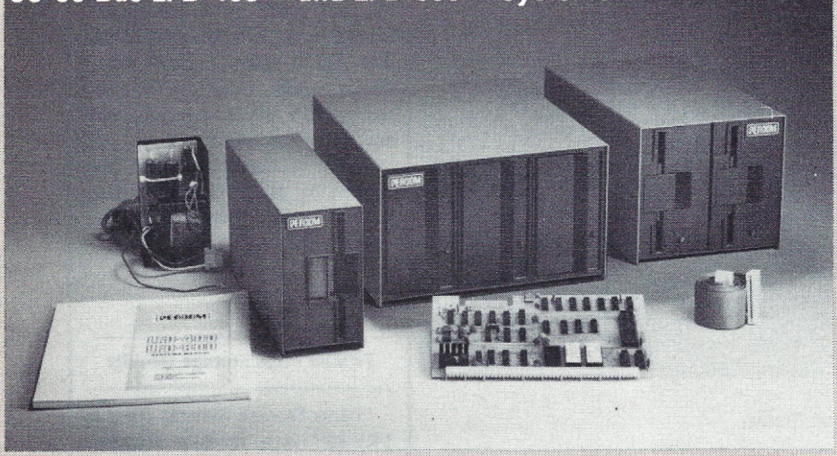
Using PET Plotter program with HIPLOT.



The Ex-850.

Welcome to Percom's Wide World

SS-50 Bus LFD-400™ and LFD-800™ Systems



Each LFD mini-disk storage system includes:

- drives with integral power supplies in an enamel-finished enclosure
- a controller/interface with ROM operating system plus extra ROM capacity and 1K of RAM
- an interconnecting cable
- a comprehensive 80-page users manual

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Low-Cost Mini-Disk Storage in the Size You Want.

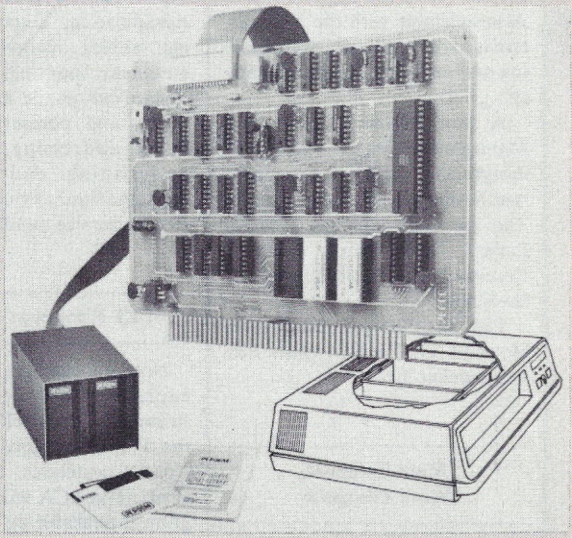
Percom LFD mini-disk drive systems are supplied complete and ready to plug in the moment they arrive. You don't even have to buy extra memory. Moreover, software support ranges from assembly language program development aids to high-speed disk operating systems and business application programs.

The LFD-400™ and -400EX™ systems and the LFD-800™ and -800EX™ systems are available in 1-, 2- and 3-drive configurations. The -400, -400EX drives store 102K bytes of formatted data on 40-track disks, and data may be stored on either surface of a disk. The -800, -800EX drives store 200K bytes of formatted data on 77-track disks.

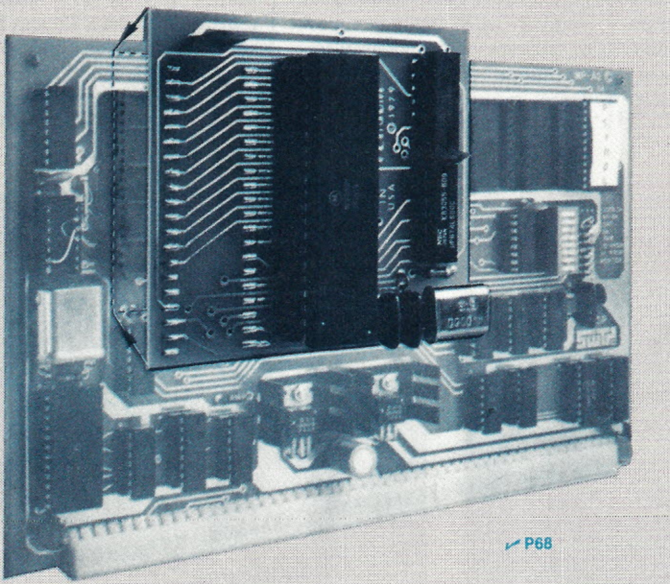
The LFD-1000™ systems (not pictured) have dual-drive units which store 800K bytes on-line. The LFD-1000™ controller accommodates two drive systems so that a user may have as much as 1.6M bytes on-line.

Mini-disk storage system prices:

MODEL	**1-DRIVE SYSTEM**	**2-DRIVE SYSTEM**	**3-DRIVE SYSTEM**
For the SS-50 Bus:			
LFD-400™	$ 599.95	$ 999.95	$1399.95
LFD-800™	895.95	1549.95	2195.95
For the EXORciser* Bus:			
LFD-400EX™	$ 649.95	$1049.95	$1449.95
LFD-800EX™	945.95	1599.95	2245.95
LFD-1000™	(dual) $2495.00	(quad) $4950.00	—



EXORciser* Bus LFD-400EX™ -800EX™ Systems



P68

Upgrade to 6809 Computing Power. Only $69.95

Although designed with the SWTP 6800 owner in mind, this upgrade adapter may also be used with most other 6800 and 6802 MPUs. The adapter is supplied assembled and tested, and includes the 6809 IC, a crystal, other essential components and user instructions. Restore your original system by merely unplugging the adapter and a wire-jumpered DIP header, and re-inserting the original components. Also available for your upgraded system is PSYMON™ (Percom SYstem MONitor), the operating system for the Percom 6809 single-board computer. PSYMON™ on 2716 ROM costs only $69.95. On diskette (source and object files), only $29.95.

Data Terminal & Two-Cassette Interface — the CIS-30+

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- Interface to data terminal and two cassette recorders with a unit only 1/10 the size of SWTP's AC-30.
- Select 30, 60 or 120 bytes per second cassette interfacing; 300, 600 or 1200 baud data terminal interfacing.
- Optional mod kits make CIS-30+ work with any microcomputer. (For MITS 680b, ask for Tech Memo TM-CIS-30+-09.)
- KC Standard/Bi-Phase-M (double frequency) cassette data encoding. Dependable self-clocking operation.
- Ordinary functions may be accomplished with 6800 Mikbug* monitor

Prices: Kit, $79.95; Assembled, $99.95. Prices include a comprehensive instruction manual. Also available: Test Cassette, Remote Control Kit (for program control of recorders), IC Socket Kit, MITS 680b mod documentation and Universal Adapter Kit (converts CIS-30+ for use with any computer).

of 6800 Microcomputing.

6800/6809 SOFTWARE

System Software

6800 Symbolic Assembler — Specify assembly options at time of assembly with this symbolic assembler. Source listing on diskette $29.95

Super BASIC — a 12K extended random access disk BASIC for the 6800 and 6809. Supports 44 commands and 31 functions. Interprets programs written in both SWTP 8K BASIC (versions 2.0, 2.2 & 2.3) and Super BASIC. Features: 9-digit BCD arithmetic, Print Using and Linput commands, and much more. Price $49.95

TOUCHUP™ — Modifies TSC's Text Editor and Text Processor for Percom mini-disk drive operation. Supplied on diskette complete with source listing $17.95

Operating Systems

INDEX™ — This easy-to-use disk-operating and file management system for 6800 microcomputers is fast. I/O devices are serviced by interrupt request. INDEX™ accesses peripherals the same as disk files — new devices may be added without changing the operating system. Other features: unlimited number of DOS commands may be added • over 60 system entry points • display only those files at or above user-specified file activity level • versions available for SWTP MF-68, Smoke's BFD-68 and Motorola's EXORciser*. Price $99.95

MINIDOS-PLUSX™ — An extension of the original MINIDOS™ for LFD-400™ mini-disk systems, MINIDOS-PLUSX™ manipulates files by six-character names. Supports up to 31 files. Resident commands include Initialize, Save, Allocate, Load, Files (directory list), Rename and Delete. Supplied on 2708 ROM with a minidiskette that includes transient utilities such as Copy, Backup, Create, Pack and Print Directory. Price .... $34.95.

PSYMON™ — Percom SYstem MONitor for the Percom single-board/SS-50-bus-compatible 6809 computer accommodates user's application programs with any mix of peripherals **without** modifying programs. PSYMON™ also features character echoing to devices other than the communicating device, sophisticated register and memory dump routines and more. Price (on 2716 ROM) .... $69.95.

WINDEX™ — Described in detail elsewhere on this page.

Business Programs

General Ledger — For 6800/6809 computers using Percom LFD mini-disk storage systems. Requires little or no knowledge of bookkeeping because the operator is prompted with non-technical questions during data entry. General Ledger updates account balances immediately — in real time, and will print financial statements immediately after journal entries. User selects and assigns own account numbers; tailors financial statements to firm's particular needs. Provides audit trail. Runs under Percom Super BASIC. Requires 24K bytes of RAM. Supplied on minidiskette with a comprehensive users manual. Price .... $199.95.

FINDER™ — This general purpose data base manager is written in Percom Super BASIC. Works wth 6800/6809 computers using Percom LFD-400™ mini-disk drive storage systems. FINDER™ allows user to define and access records using his own terminology — customize file structures to specific needs. Basic commands are New, Change, Delete, Find and Pack. Add up to three user-defined commands. FINDER plus Super BASIC require 24K bytes of RAM. Supplied on minidiskette with a users manual. Price $99.95

Mailing List Processor — Powerful search, sort, create and update capability plus ability to store 700 addresses per minidiskette make this list processor efficient and easy to use. Runs under Percom Super BASIC. Requires 24K bytes of RAM. Supplied on minidiskette with a users manual. Price $99.95.

From the Software Works

Development and debugging programs for 6800 μCs on diskette:

Disassembler/Source Generator	$30.95
Reloc'tng Disas'mblr/Segmented Text Gen	$40.95
Disassembler/Trace	$25.95
Support Relocator Program	$25.95
Relocating Assembler/Linking Loader	$55.95
SmithBUG** (2716 EPROM)	$70.00

½-Price Special on Hemenway Software!

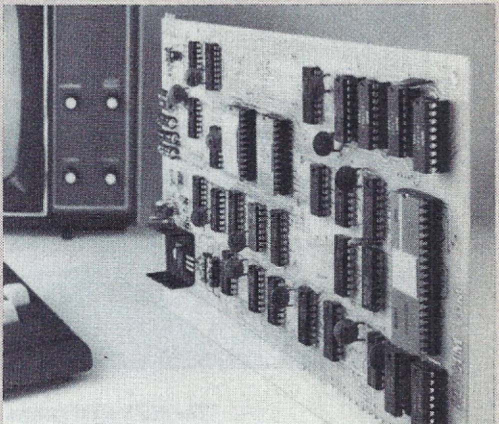
CP/68‡ disk operating system	$ 49.97
STRUBAL+‡ compiler	$124.97
EDIT68 text editor	$ 19.97
MACRO-Relocating Assembler	$ 39.97
Linkage Editor (LNKEDT68)	$ 24.97
Cross Reference utility	$ 14.97

™trademark of Percom Data Company, Inc. P70
* trademark of Motorola Corporation
‡Trademark of Hemenway Associates Company
**SmithBUG is a trademark of the Software Works Company

And 'looking into' is just what you do with the Electric Window™ as you peer right into memory space where characters are being input and manipulated. Display is memory-resident, programmable and generates up to 24 80-character lines.

Other features include:

- standard character generator plus provision for optional special character generator
- dual intensity, high-lighting alphanumeric display
- scrolling by a programmable register • programmable display positioning
- programmable interlaced or non-interlaced scan
- descenders on lower case letters • users manual with application instructions and listing of WINDEX™ driver.



The Electric Window.™ Worth Looking Into. $249.95

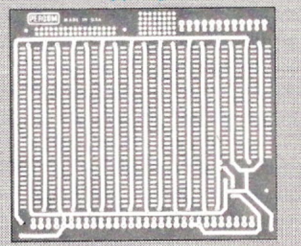
WINDEX™ is a fast video display driver program for the Electric Window™. WINDEX™ also features: program and keyboard control of character generators • displayable control characters — under program control • automatic scrolling • a driver routine for the parallel input keyboard feature of the Percom 6809 Single-Board Computer, the SBC/9™ • auto-linking to PSYMON™, the ROM operating system for the SBC/9™ • Prices: ROM version: $39.95; LFD-400™ compatible diskette (source and object files): $29.95. P71

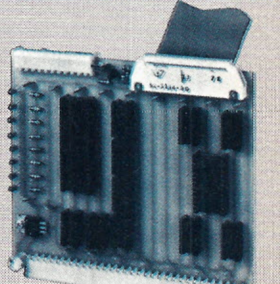
PDQ from PDC! P72

In the product development queue and available soon: **the SBC/9™** (Single-Board-Computer/6809) — stands alone as a control computer, but also compatible with the SS-50 bus for use as an MPU card. Includes PSYMON™ (Percom SYstem MONitor) in a 1K ROM and provides for additional 1K of ROM. Also includes 1K of RAM. Features: Super Port — provision for multi-address, 8-bit bidirectional data lines • an intelligent data bus for multi-level data bus decoding • an on-board 110-baud to 19.2 kbaud clock generator • extended address capability — to 16 megabytes — without disabling baud clock or adding hardware. And much more. Supplied with PSYMON™ and comprehensive users manual. Price .... $199.95.

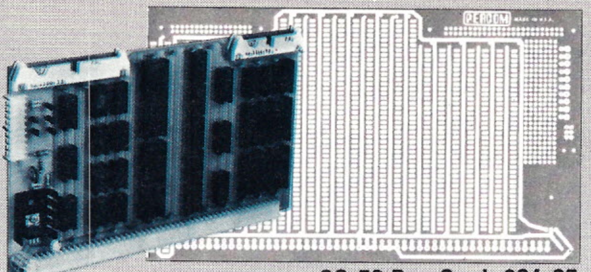
Full Feature Prototyping PC Boards

All of the features needed for rapid, straightforward circuit prototyping. Use 14-, 16-, 24- and 40-pin DIP sockets • SS-50 bus card accommodates 34- and 50-pin ribbon connectors on top edge, 10-pin Molex connector on side edge • I/O card accommodates 34-pin ribbon connector and 12-pin Molex on top edge





I/O Bus Card: $14.95



SS-50 Bus Card: $24.95

- I/O card is 1-¼ inches higher than SWTP I/O card • interdigitated power conductors • contacts for power regulators and distributed capacitance bypassing
- use wire wrap, wiring pencil or solder wiring • tin-lead plating over 2-oz copper conductors wets quickly, solders easily
- FR4-G10 epoxy-glass substrate.

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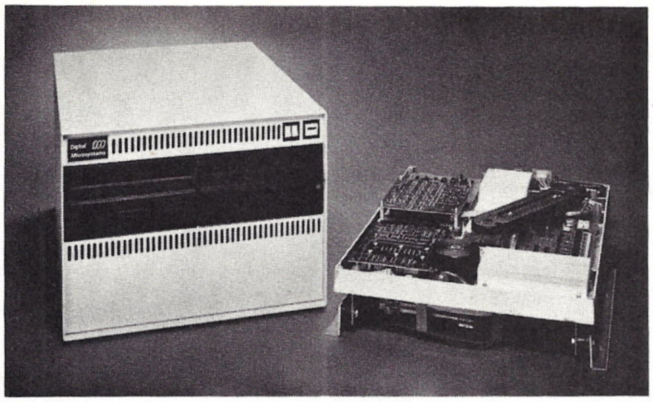
To place an order or request additional literature call toll-free 1-800-527-1592. For technical information call (214) 272-3421. Orders may be paid by check, money order, COD or charged to a VISA or Master Charge account. Texas residents must add 5% sales tax.

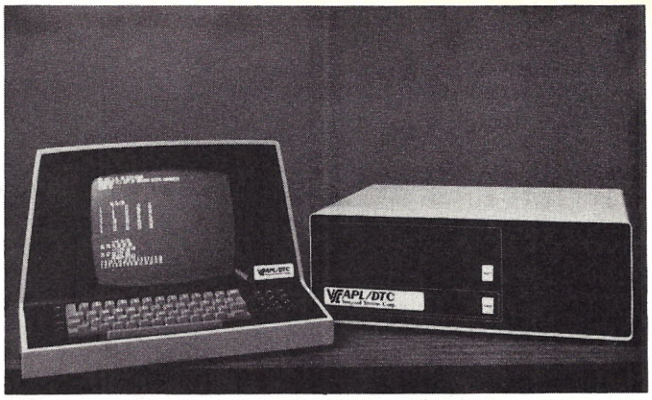
PRICES AND SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

PERCOM

PERCOM DATA COMPANY, INC.
211 N. KIRBY GARLAND, TEXAS 75042
(214) 272-3421



The HDS-4000 system.



The APL/DTC.

cables and power supply. The interface is via an 8-bit parallel port.

The high-speed disk controller includes error-correction hardware that will detect almost any error and correct up to a 6-bit error burst. The intelligent controller, with its 32K bytes of buffer storage, can be microprogrammed to perform much of the file access overhead and reduce the computational load on the host computer. The flexible interface can accommodate different host computers.

An added feature is the head per track storage option. This option adds eight fixed heads on the bottom surface to yield 136K bytes of high-speed disk storage. This can improve throughput by reducing seek time on frequently accessed files or directories. Either the field-proven CP/M or the new OASIS operating system is available with the HDS-4000 with no modifications needed to existing programs. The HDS-4004 with 13.7 Mbytes, controller, cabinet and power supply is $5495; the HDS-4008 with 27.4 Mbytes, controller, cabinet and power supply is $6995.

Digital Microsystems, 4448 Piedmont Ave., Oakland CA 94611. Reader Service number D44.

APL Micro

The APL/DTC, a desktop microcomputer offering the full power of the APL language, is a complete hardware/software configuration that includes a 4 MHz Z-80-based central processor, two quad-density mini-disk drives, video terminal, APL character generator, object code disk and documentation. It gives APL users 24K bytes of usable active APL workspace, which can be expanded—as an option—to 36K.

The standard APL/DTC system includes one auxiliary processor for interfacing input/output ports and another to implement a versatile indexed file system. Three additional auxiliary processors are available as options: one for data communications, one for high-resolution graphics manipulation and one for analog-to-digital conversion in control applications.

Because the APL/DTC uses a standard CP/M operating system, users may run many languages besides APL. Optional software packages for BASIC, FORTRAN, COBOL and PASCAL languages, a Z-80 assembler and word-processing software are all useful on this machine. This flexibility makes the APL/DTC especially useful in educational applications. The standard APL/DTC has a wide range of options that can be added to tailor it precisely to specific APL uses. Price is $6495.

Vanguard Systems Corporation, 6812 San Pedro, San Antonio TX 78216. Reader Service number V1.

Code Converter

The ABM-100, a new single-board code converter, translates between ASCII and Baudot or Baudot and ASCII. Utilizing a pair of MK-3870 single-chip microcomputers, the board provides two independently programmable serial data reports that are internally connected. Programming is accomplished by using on-board DIP switches for selecting the baud rate, line length and data format for each of the two ports.

Eight different baud rates—from 110 to 1200 baud ASCII and 45.45 to 74.2 baud Baudot—are provided. Output line lengths of either 40, 64, 72 or 80 characters are also selectable. Other features include a built-in FIFO buffer and interfaces for both RS-232 and 20/60 mA current loop operations, plus speed conversion capability.

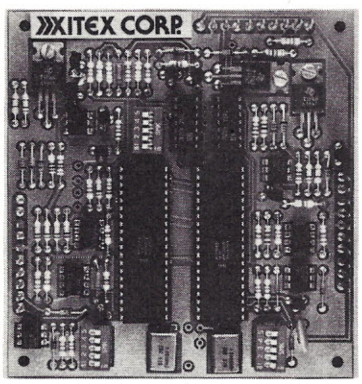
A third port for translation between Morse code and either ASCII or Baudot is provided. This permits the generation and decoding of Morse signals (dc levels) using conventional ASCII or Baudot equipment. Price is $129.

Xitex Corporation, 9861 Chartwell Drive, Dallas TX 75243. Reader Service number X4.

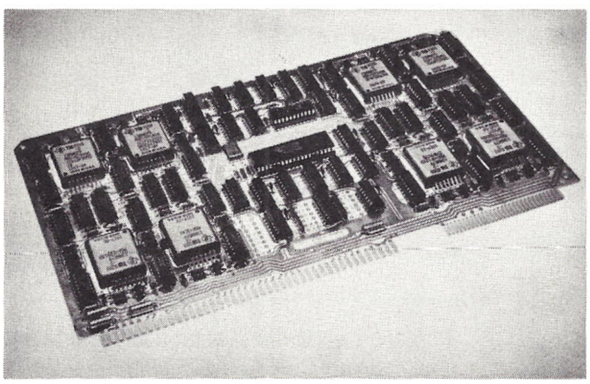
Bubble-Memory System

The MBB-80 Bubbl-Board is the first ready-to-operate magnetic-bubble mass-storage memory add-in for the SBC-80 family of single-board microcomputers originated by Intel, Inc., and also manufactured by National Semiconductor and Monolithic Systems, among others. The new SBC-80-compatible bubble-memory system is entirely contained on a single multi-layer printed-circuit module that consumes just one slot in the SBC-80 card cage. Nonvolatile storage is provided for 92,304 bytes of data. All necessary bubble-device control and Multibus-interface logic is self-contained on the board; no additional logic is required.

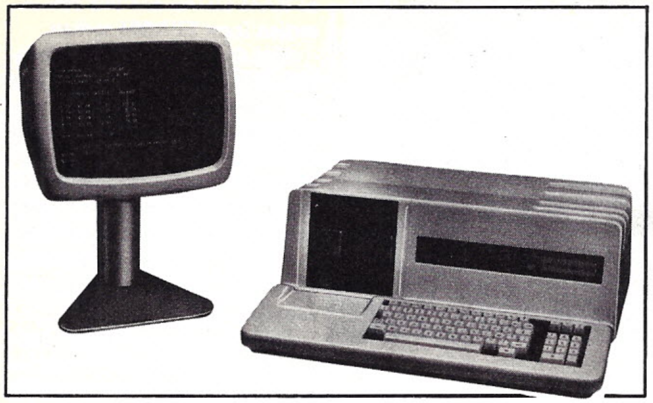
Access time to the first addressed byte is less than 7.3 milliseconds, and the data transfer rate is in excess of 45,000 bits per second. Power consumption for the bubble-memory system is less than 20 Watts. Logic is incorporated on-board to protect data against inadvertent system power loss. The bubble-memory system can be used successfully in dirty or dusty environments that would preclude the use of moving mechanical parts, in hospitals and business offices where the noise of a disk or



The ABM-100.



The MBB-80 Bubbl-Board.



Model 80-30.

tape mechanism would be objectionable, or in process-control and data-acquisition applications that must operate 24 hours per day and would soon wear out mechanical systems. Price is $1695.

Bubbl-Tec, 3120 Crow Canyon Road, San Ramon CA 94583. Reader Service number B55.

Business Computers

The Series 80 from R2E of America, 47 Bedford St., S.E., Minneapolis MN 55414, is a family of Z-80-based microcomputer systems. The model 80-30 includes the Z-80 CPU, 32K of RAM (64K optional), two double-side double-density minifloppy drives (each providing 280K bytes of storage), a 1024 character upper/lowercase CRT on a pedestal mount, an ASCII keyboard, a parallel Centronics printer interface, cabinet and power supply. The model 80-31 is similar to the 80-30, but includes a tabletop 1920 character upper/lowercase CRT.

A 10 megabyte removable cartridge disk drive with its own cabinet and power supply can be added to these systems, then designated as models 80-30D and 80-31D. The drive packs 10 megabytes of storage onto a removable cartridge of only 10.5 inches in diameter. The Series 80 microcomputers are also available with a graphics CRT option, featuring 256 × 256 point resolution.

Software for the systems includes an assembler, an advanced business applications BASIC language (BAL) with a sequential and random access file management system and, optionally, the CP/M operating system. Reader Service number R30.

Apple II Real-Time Clock

The Model APT-1 is a real-time clock for the Apple II computer. Six digit time information can be displayed on the screen and printouts or used for timing events, controlling other peripherals, data logging, etc.

Included with this peripheral board, dubbed the Appletime, is an external wall transformer that keeps the clock running when the computer is turned off. Other features include: 12/24 hour, ac/crystal timebase and BCD or ASCII data format. The Appletime plugs into any slot of the Apple II and can be used with machine-language or BASIC programs. Price is $79.95.

West Side Electronics, PO Box 636, Chatsworth CA 91311. Reader Service number W32.

Word-Processing Business System

The Algo-2100 system offers word processing and information processing in a single office system. The Algo-2100 system hardware includes a main processing unit with 48,000 characters of high-speed memory, dual floppy disk drives, a 24 line by 80 character video display and a 540 wpm letter-quality daisy wheel printer. Word-processing software is standard. New system software, periodically issued on floppy disk, is also available.

Word-processing features provided by the Text Editor include: four-way cursor movement, word-wrap, search and replace, unlimited text insertion, overstrike corrections, delete (word, line and block), block copy and block move. Document formatting is achieved with more than 40 automatic operations including: repagination, centering, page titling, numbering in Arabic and Roman numerals, headers and footers and justification. An operator can fill in pre-printed forms and combine stock phrases into finished text. Documents are stored on floppy disks, where they are cataloged and easily retrieved. Up to 190 columns can be printed. One (or more) of 35 different type fonts in three sizes can be combined on a single page. Prices begin at $10,800.

Algorithmics, Inc., 177 Worcester Rd., Wellesley MA 02181. Reader Service number A109.

Cash Register Interface

The ECRI cash register board allows you to interface from a TEC cash register to an S-100 bus computer. You can consolidate sales from more than one cash register. Part number input for inventory control, data transfer direct from cash register input to general ledger, direct terminal readout of data and additional data display from computer memory are all possible applications with this low-cost, computerized cash register system.

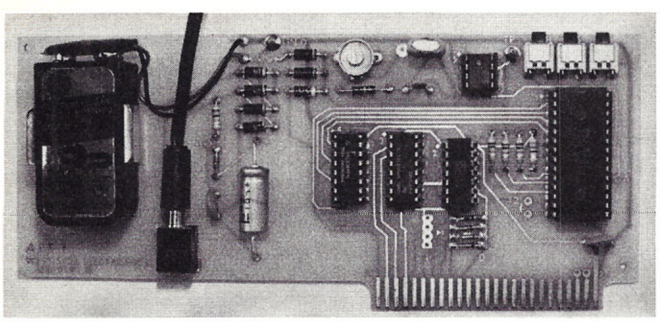
The ECRI interface plugs right into the computer and ties directly to the cash register. The interface provides a buffered output system that allows simultaneous operation of more than one cash register. The computer accesses the buffer on a polled basis, allowing it to be operated as a computer while servicing cash registers. With computerized data, every transaction can be printed out or stored. Price is $495.

Electronic Cash Register Interface, 1555 Morse Ave., Ventura CA 93003. Reader Service number E52.

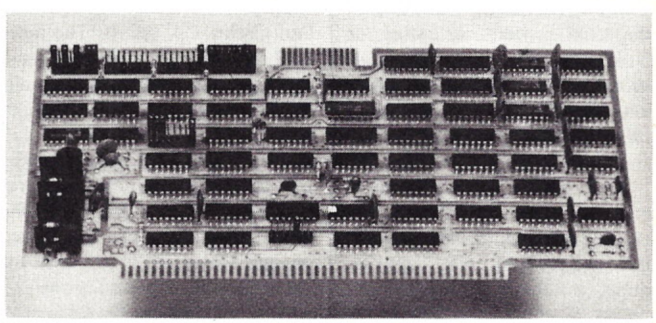
FORTRAN IV String-Handling Package

STRING70 is a general-purpose character string-handling package for FORTRAN IV users that runs on virtually all minicomputer systems and microcomputer systems that support FORTRAN (and mainframes, too). STRING70 consists of ANS FORTRAN IV subroutines and provides the user with a full complement of string-handling functions that all operate on variable length character strings and substrings. Symbol-table-oriented functions are also provided as part of the package.

The package of features includes string comparisons, string moves, string searches, string concatenation, string insertion, string deletion, string replacements and string fills. Table-oriented functions include binary search, insertion and deletion of table en-

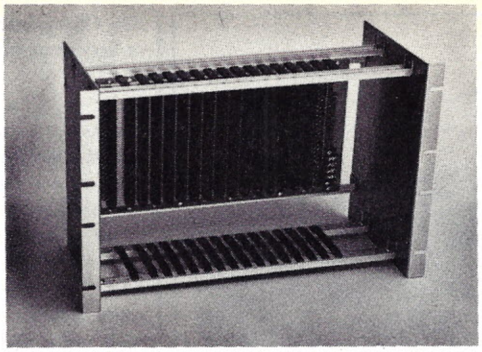


The Appletime.



The ECRI board.

CRT turntable.



Artec's new card cage.

tries. Applications include variable listing output formats, text processing, text editors, text input scanners and parsers, printer (or CRT) output processors, symbol table processing, string (or numeric) sorting, binary searching and custom I/O access methods. STRING70 is available at a one-time lease of $95 and is supplied in source deck form with supporting documentation. Source is also available on magnetic tape and paper tape.

Software '70, Box 3623, Anaheim CA 92803. Reader Service number S116.

Home-Brew Products

Have you ever wondered what ingredients are contained in common household products you use everyday? Homebrew Products program can tell you. And, with this knowledge, the consumer can save on the price of domestic products (from antiperspirant to window cleaner). The program lists simple, easy ways to make these products from scratch in your home.

Once the program has been loaded and run, you need only type and enter the name of a product to cause a listing of its ingredients to be displayed, along with all information necessary to mix these ingredients, most of which can be readily purchased at the local grocery, drugstore or building supply company. Besides its ease of use, Homebrew Products is also fast—information retrieval time ranges between a fraction of a second to 5 seconds.

The program, which will run on any 16K Level II TRS-80, is capable of checking itself to see if it loaded properly. Also, upon request, a complete listing of the names of all the products in the system's repertoire will be displayed. Price is $16.95.

Computrex, PO Box 536, Inman SC 29349. Reader Service number C86.

CRT Lazy Susans

You can facilitate the sharing of the CRT between operators with lazy Susans from The Computer Accessories Company, 20 Boat Lane, Port Washington NY 11050. The units are made to fit the specific model of your CRT and keyboard. Its ball-bearing construction allows quiet and smooth turning. A center hole through the entire unit facilitates the installation of the CRT wiring and prevents wire abrasions.

The standard units turn 180 degrees with a stop to prevent continuous 360 degree turning, thus eliminating problems with twisted wiring. The turning arc can also be changed for any specific requirement. The turntables are finished in an "off white" to match the color of most CRTs. Other colors can be ordered to meet specific decorating needs. Reader Service number C154.

Card Cages

A new line of rack enclosures, or card cages, to support memory board and CPU card products has recently been introduced by Artec Electronics, 605 Old County Rd., San Carlos CA 94070. The new card cages allow S-100 microcomputer systems designers to meet all of their basic needs from a single supplier.

Constructed of 12-gauge anodized aluminum, the card cages are rack-mountable in standard 19-inch equipment racks and offer enough variations in capacity to allow the user to select the one exactly suited to his needs. Currently available are 6-, 8-, 10-, 12- and 16-slot versions. Memory and CPU cards are easily inserted into and removed from the card cages without tools and without connecting and disconnecting cables.

The motherboards in all configurations are constructed of sturdy, 1/8-inch FR4 glass epoxy. The 10- and 16-slot card cages are available with Artec's silent, shielded motherboard, which virtually eliminates noise in the bus lines. Price is $65 for a 16-slot version; other sizes are also available. Reader Service number A104.

KIM Expansion Board

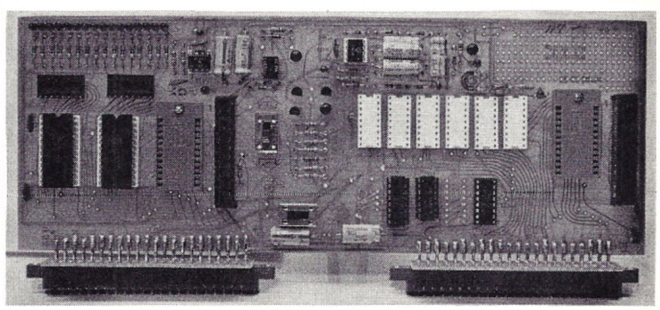
The More Board is an easy-to-install and use expansion for the basic KIM, AIM or KIM-compatible microcomputer. The More Board and a KIM, or equivalent, computer make versatile dedicated controller, educational tool, hobby computer expansion or development system. Another unique feature of this board is its ability to program, run or copy industry standard EPROMs—2708, 2716 (±5 and +12) or 2716, 2758, TMS 2516 (+5 V only).

Individual program and run personality keys and software allow the user to program from RAM or copy data from any given EPROM into any other type EPROM (for example, empty two 2708s into one 2716!). Additionally, the board has sockets for 3K of RAM (2114s) and two zero insertion force EPROM sockets.

Also featured is a 16-bit latchable buffered output port with two DIP headers for access. Associated with this port is a row of 16 LEDs arranged in binary sequence. All voltages necessary to run and program the EPROMs are generated on-board. Only +5 and +12 volt supplies are required (approximately 200 mA from each supply).

Standard 22-pin edge connectors allow the board to plug into the KIM or KIM-compatible micro. All signal lines are passed through the More Board and made available in total on standard 22-pin paddle cards. The price ($169.95) includes eight personality keys, documentation and software listings. Options include software on tape for AIM or KIM ($10) and software in 2708 EPROM ($30).

TTI, PO Box 2328, Cookeville TN 38501. Reader Service number T71.



The More Board.

Free Apple Catalog

A free Apple software catalog is now available from Rainbow Computing, Inc., 9719 Reseda Boulevard, Northbridge CA 91324. The 45-page book, billed as "the largest collection of software for the Apple computer ever assembled," includes over 100 games of all types, business applications and software development programs. The software vendors, including Rainbow Computing, Inc., selling these programs are listed in the catalog.

Programs on cassette and diskette range from $10 to $20. A typical of this are Rainbow Computing's 49 games and demos on a single cassette, for $49. The catalog also contains a list of accessories for the Apple, including music and speech synthesis, appliance control and other interface cards, along with add-on memory.

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Don Lancaster
Synergetics

Lowercase for Your Apple II (Part 1)

Expand the usefulness of your Apple with this inexpensive addition.

With a few modifications and some new software, you can plug a TVT 6-5/8 lowercase module A into an Apple II.

These simple changes turn your Apple II into a combined uppercase and lowercase computer and can cost you as little as $10. Your new lowercase ability frees your Apple to do word processing, text editing and typesetting, generate mailing lists, write form letters and so on. The modifications require two extra integrated circuits added to the breadboard area already on the Apple. If you like, you can get by with only add-on wires and no foil cuts.

The change-only-the-character-generator approach doesn't tie up or restrict blocks of ROM, RAM or graphics display memory. What we are about to show you is also totally invisible—your Apple II stays an uppercase machine till you specifically ask for some lowercase output. Software does the switchover at any time, and the regular Apple II keyboard is used for both uppercase and lowercase.

There are two minor limitations to this conversion. If you still want to be able to reverse video, you may have to add a changeover switch, which gives you a choice of reverse video or lowercase. You'll also find that lowercase characters will be flashed more attractively with software rather than hardware. The method we'll show you should work on many other terminals and computers, if they use a new style 2513 character generator and have a full 8-bit-wide display memory.

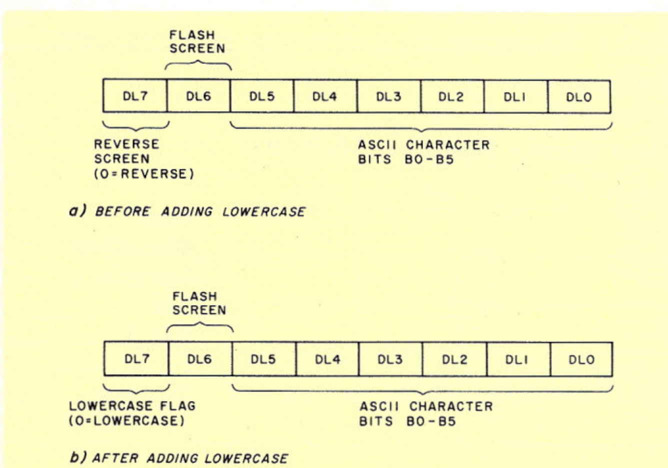

Fig. 1. Bit definitions of Apple II character DL bus.

Some Details

Just adding lowercase to any old computer or terminal sounds simple enough. Plug in an uppercase and lowercase combined character generator, and you are home free, right?

Well, not really. First and foremost, you have to want to do something useful with your new lowercase characters. While they are nice to look at for displays and some games, unless you have a printer or other output that needs and uses lowercase, you really haven't gained very much. So if you want the new characters, make sure you have some way to get them out of the machine. An important rule is to *make sure you have some use for lowercase before you go to the trouble of providing it.*

An obvious problem that immediately crops up involves the keyboard and its encoder electronics. The Apple II has an uppercase-only keyboard. An old National chip was used for the encoder. This chip is strictly uppercase only, compared to the usual 2376 with its choice of coding options. The Apple keycaps, particularly those on the M and the P, will also limit how you can use the existing keyboard. And there are no spare keys to speak of.

We'll show you how to use software to trick the existing Apple II keyboard into giving us lowercase when and where we want it. The software secret is to use the Escape key as a shift lock for lowercase. More on this later.

Another problem is created by the firmware in the Apple II. The operating systems and monitor are needed for machine language, for the mini-assembler, for Integer BASIC and for AppleSoft.

All four of these languages demand uppercase only, and the firmware is happy to provide it. In fact, most of the sequences go to a lot of trouble to make sure that everything is uppercase. Put in lowercase, and the sequences will convert it back for you. Even the winking cursor forces an uppercase-only output. So, even if you force-feed your Apple from a new lowercase keyboard, the internal firmware will try to change it all back to uppercase anyway.

The way around all this is to use some new software that bypasses the firmware when and if we need lowercase. This is a key to full alphanumerics. We have to make sure that everything we do stays fully invisible and appears to be uppercase only, unless we specifically call for the new characters.

Our modifications meet these goals:

- The existing keyboard is used

DL7	DL6	Screen
0	0	Black characters, white background
0	1	Flashing character, black background
1	0	White character, black background
1	1	White character, black background

Table 1.

DL7	DL6	Screen
0	0	White lowercase characters
0	1	Flashing characters
1	0	White uppercase characters
1	1	White uppercase characters

Table 2.

without any changes.

- Apple hardware changes consist of two new ICs in the breadboard area and a plug-in module. No foil cuts are needed.
- Lowercase is completely invisible until it is called with software.
- No hi-res graphics or large blocks of ROM and RAM are tied up.

Fig. 1 shows us the old and the new bit assignments for the Apple II display memory, or DL bus. The lower six bits are used for the ASCII character code, arranged in the usual order. The next bit is DL6. It's used to flash the screen. Screen flashing is most often used for the cursor, but it is also convenient for alarm or error messages.

The final bit is DL7. It was originally used to reverse the screen display. This gives you black characters on a white background, and is normally used for emphasis.

Lines DL6 and DL7 are not independent. You cannot flash a white screen; you can only flash a black screen. The truth table for these two lines before modification is shown in Table 1. If it weren't for the interaction between these two bits, some capital letters would always flash with the existing Apple II firmware.

The obvious thing to do is make DL7 equal to the seventh ASCII line needed for your new character generator. But there doesn't seem to be any reasonable way to do this and still have invisible operation when you *don't* want lowercase. Instead, we use DL7 as a lowercase flag. If DL7 is a 0 *and* if DL6 is a 0, then we want lowercase out of our character generator. Otherwise, we want everything to stay just the way it was. Table 2 shows our truth table after modification.

Once again, the reason we do this in a nonobvious and seemingly complicated way is to keep compatibility with everything that is already working in your Apple II.

The hardware modifications involved are simple and inexpensive, but you should not attempt them if you aren't adept at adding wires to a printed circuit board, reading socket pins and so on. There are three things involved in the hardware changes:

- The character generator is replaced with one that also generates lowercase.
- A new integrated circuit gate is added to decode lowercase for the character generator.
- A new integrated circuit gate is added to prevent lowercase characters from appearing as black on white.

The first change is done using a TVT 6-5/8 module A. This consists of an $8 uppercase and lowercase MCM6674 character generator mounted on a small adapter card that plugs into the existing 2513 character generator socket. The second two changes involve 15¢ integrated circuits added on new sockets in the Apple breadboard area. One direct IC-to-IC wire is used to eliminate the need for any foil cuts.

The schematic of the lowercase modification for the Apple II is shown in Fig. 2. Character generator A5 is unplugged and replaced with a TVT module A that carries a new uppercase and lowercase MCM6674P character generator. A new wire is routed to pin 23 of A5 that carries the new seventh ASCII bit A6 needed for the dual-case operation.

The logic rules for this new lead tell us to make A6 the complement of A5 for uppercase, numerals and punctuation, but to make A6 a 1 for lowercase. This lowercase condition happens when DL6 and DL7 are both zeros.

A new 74LS02 quad NOR gate integrated circuit is put in the breadboard area at A11 to do this A6 logic conversion for us. The gate outputs a 1 if DL6 and DL7 are both 0, and otherwise outputs the complement of DL5. The reasons behind this logic are apparent if you study the ASCII coding involved.

If we simply changed the character generator and added a quad NOR gate, we would get invisible normal operation and lowercase when we called for it. The only hassle involved is that the lowercase would appear as reverse video, with black characters on a white background. To beat this final problem, we add a second integrated circuit in the breadboard area A13. A13 outputs a signal for us that is low only when the flashing condition of DL6 = 1 and DL7 = 0 takes place. Otherwise, a 1 is output that forces the normal white-on-black screen display.

Note that the original DL7 connection going to pin 6 of B13 has to somehow be broken. This can be done by cutting foil, but a safer and more reversible way is to bend pin 6 of B13 out of its socket and make a direct topside wire connection.

There is one final detail we must attend to in the modification for lowercase. The Apple II still applies unused negative voltages to pins 1 and 12 of the character generator. This probably dates back to the days when some 2513s needed these supply voltages, or else is a hedge should a different part be needed. At any rate, *an unmodified TVT module A will short out the power supplies if it is plugged into an unmodified Apple II.* Fig. 3 shows us several ways out of this bind. Anything that keeps a short off the −5

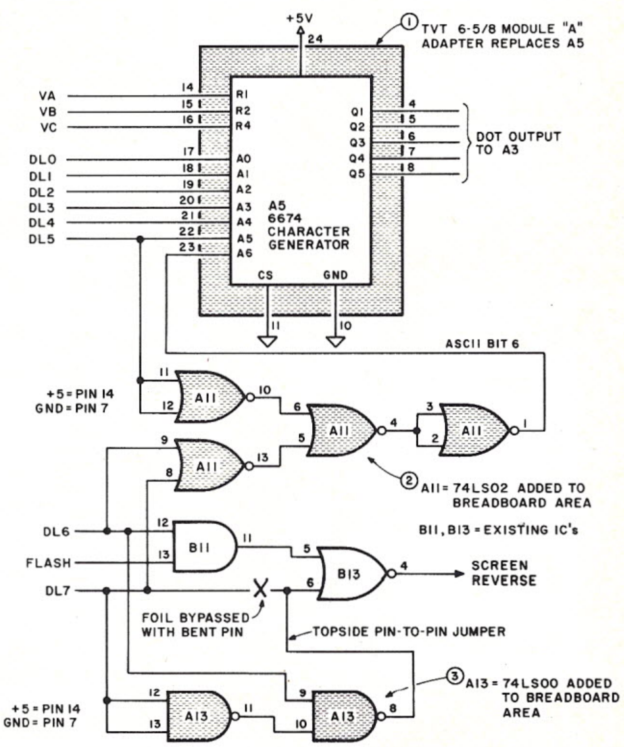

Fig. 2. Schematic of Apple II lowercase modifications.

- Leave pins 1 and 12 off of module A during assembly

or

- Bend pins 1 and 12 of module A up and out of the road

or

- Cut pins 1 and 12 of module A flush with its circuit board

or

- Use a PC layout for module A that floats pins 1 and 12

or

- Cut the foil on the dead-end supply lines going to pins 1 and 12 of character generator A5 on your Apple II.

Fig. 3. Do not plug an unmodified TVT Module A into an unmodified Apple II! The Apple II provides live but unused negative supply voltages to pins 1 and 12 of its character generator. Here are several routes to Module A compatibility.

and −12 lines will work.

Hardware Changes

As with just about anything in the new computer world, both hardware and software are involved. If you make only the hardware changes we are about to look at, your Apple II will still behave just as it did before, with the only exception being the loss of screen reversal. To actually use lowercase, we have to add new software as well.

Our new software will be in the form of short integer BASIC programs and sequences. Once you decide what you really want to do with your lowercase Apple, you can use these sequences as they are, integrate them into your working programs or convert them up to Applesoft or down to machine language. We'll be giving you more than enough software to get you started.

Fig. 4 repeats the details of the TVT module A from the *Cheap Video Cookbook* (Sams 21524). We have changed the callouts around to match the Apple's and have eliminated pins 1 and 12 from the module to eliminate the supply-shorting problem.

Module A Assembly

Carefully inspect the circuit board for opens, solder bridges, etc. Try tinning one of the runs on the board. If there is any problem with easy solder adhesion, carefully clean all the areas to be soldered with an ordinary pink eraser. Avoid handling the board, as it will make soldering more difficult.

Set your PC board bare side up with the notch in the upper left-hand corner. Insert a 0.1 uF disk ceramic capacitor in the two middle, left-most holes. Solder the capacitor in place. Clip and save the excess leads.

Use one of the leads left over from the previous step to provide a jumper in the two middle, right-most holes.

Use the other remaining lead to provide a jumper immediately to the left of the one you just installed. Solder both jumpers in place.

Add an 18-pin integrated circuit to the remaining middle holes. If the socket has orientation marks or notches, point these toward the capacitor.

Shorten one of the 12-pin strips so it is only 10 pins long. Center this strip above the socket. The long end of the pins and the spacer go on the bare side; the short pin side goes to the foil. Solder in place after making sure that the strip is flat and that one hole remains unused at each end of the strip.

Add a 12-pin strip to the remaining 12 holes at the bottom. Be sure this strip is flat before soldering and that it points the same direction as the previous strip.

Carefully study the foil side in Fig. 4 and add the following four wire-pencil connections to the foil side:

IC pin 12 to module pin 4
IC pin 13 to module pin 5
IC pin 15 to module pin 7
IC pin 16 to module pin 8

Note: Be sure you understand the pin numbering before you start. On the foil side, the connector pins run *counterclockwise*. The 18-pin IC socket pins run *clockwise*. The end jumper and capacitor holes are *not* counted. There are no module pins at locations 1 and 12.

Check the previous step. Your four connections should form a cross within a cross that reverses the sequence of five side-by-side pad pairs.

Insert an MCM6674P character generator into the module, *putting the notch at the capacitor end.* You may have to gently force the pins on the IC slightly together by rotating the IC against a tabletop or bench.

Store your completed module in protective foam at all times.

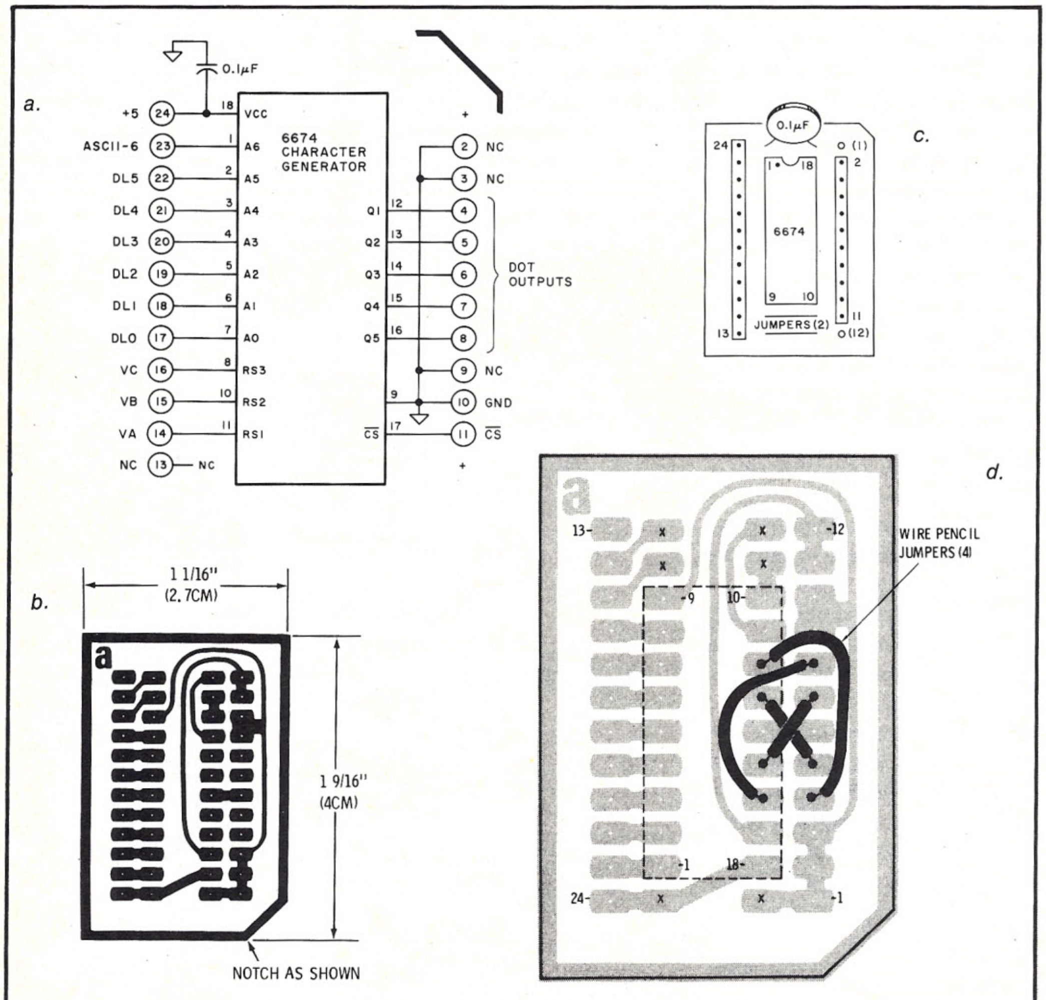

Fig. 4. Construction details on module A.

NorthStar

1 TVT module A lowercase plug-in with floating pins 1 and 12 (Fig. 4).
2 14-pin integrated circuit sockets
1 74LS02 quad low power Schottky TTL NOR gate
1 74LS00 quad low power Schottky TTL NAND gate
1 Length of #24 solid, insulated wire, around two feet long.
1 Length of electronic solder suitable for PC board use, around two feet long.

Phillips Screwdriver
1/4 inch nutdriver (optional)
Needle-nose pliers
Diagonal cutting pliers
Wire stripper
Small soldering iron

Fig. 5. Parts and tools list to add lowercase to an Apple II.

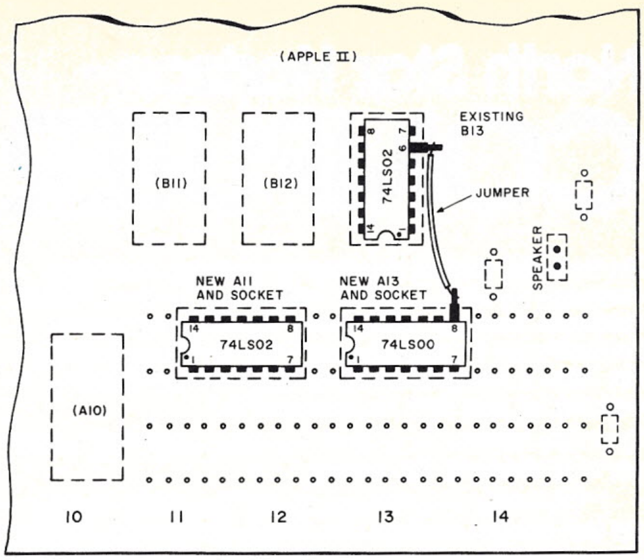

Fig. 7. Top view of lowercase modifications. Jumper shown eliminates the need for foil cut.

This completes assembly of your module A.

Lowercase Modification

Fig. 5 provides a list of the tools and parts you will need for your Apple II modifications. If you know how to solder on a printed circuit board and are familiar with PC socket numbering, the changes should be inexpensive and easy to do. If you aren't into this sort of thing, or if chopping and channeling a $1000 computer is against your religious convictions, have somebody else do the work for you.

Turn your Apple II off and remove the power supply. Remove all video cables and cassette cables.

Lift the lid off the Apple II by pulling sharply up at the left of rear center and then at the right of rear center to unsnap the Hedlok fasteners. Set the lid aside.

Carefully unplug any remaining rf modulator cables, game paddles or other I/O connections, and any plug-in cards, making careful note of where they go and how they are oriented.

Place the Apple II upside down on a bench that is protected with a rug or a foam pad.

Remove the four semi-recessed Phillips head screws at the bottom front (Fig. 6). Set them aside in a safe place.

Remove only the six outermost Phillips head screws from the bottom. There should be two at the extreme left, two at the extreme right and two at the extreme rear. Set these screws aside. *Do not remove any other screws!* Often the outside six screws are a slightly different color than the others (Fig. 6).

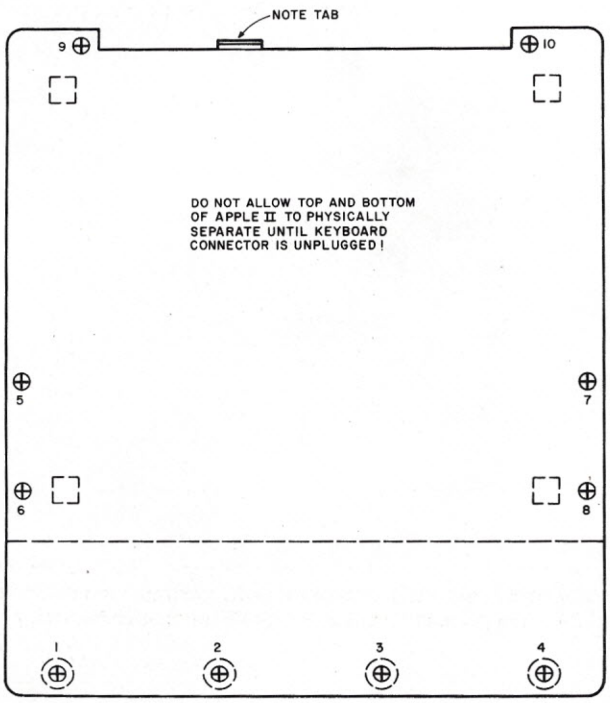

Fig. 6. To disassemble your Apple II, remove only the screws shown here.

While you are carefully holding the top and bottom of the computer tightly together, turn the computer over so it is right-side up.

Gently lift up the front of the computer only far enough that you can see inside. Note the keyboard connector that plugs into location A7. Gently remove this connector from the main computer board end.

Check the rear of the main circuit board by the video jack. If an rf modulator or something else is plugged into the four-pin connector at K14, carefully remove it.

At this point there should be nothing preventing you from removing the top of the case. Remove the cover and set it aside. Note: The pins on the keyboard connector and the unprotected speaker cone are easily damaged. Be gentle!

Note how the integrated circuits are numbered by column and alphabetized by row. Verify that (1) there is a 2513 character generator at A5; (2) there is a breadboard area at A11 through A14; (3) all integrated circuits have code notches and dots that line up pin 1 with white dots on the circuit board.

Unplug the power supply connector. Pry gently against the plastic clips on either end of the socket to release them.

Remove the 6-32 nut and washer in the center of the main computer board near F8.

Unplug the speaker connector.

Note that there are six white nylon board supports. Be sure to note the one at J9.

Gently squeeze the support at A1 with your needle-nose pliers till the barb releases the board. Lift the board up only far enough to free it from the barb.

Release the other barbs, one at a time, starting with A14, followed by J9, K14, K9 and, finally, K1.

Remove the circuit board from the computer. Set all the computer parts aside except for the circuit board.

Study Fig. 7. Add a 14-pin integrated circuit socket to A11, so that it straddles the uppermost breadboard row, starts in the third hole from the left (two holes show at socket left) and has any notches or dots oriented to the left. Tack the IC socket in place at pins 1 and 8. Then remelt these pins while pushing down on the socket to make sure the socket is solidly seated. Solder all 14 pins from the foil side.

Skip two holes and add a second 14-pin integrated circuit socket immediately to the right of the first one. It should also straddle the upper two rows and should have seven holes visible on the right and two holes visible between the sockets.

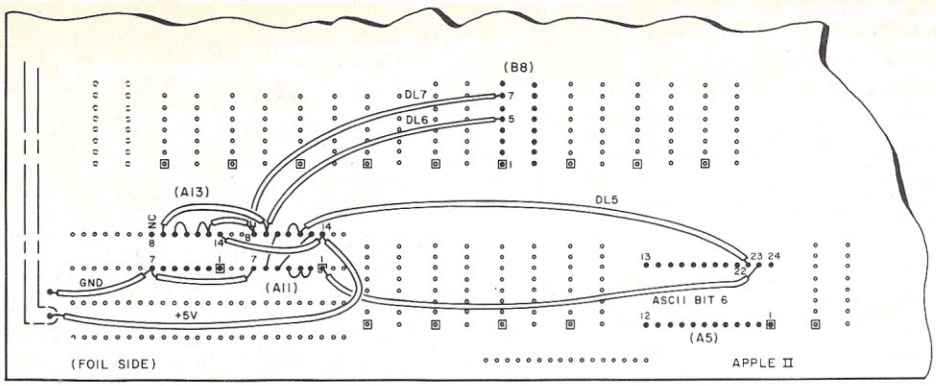

Fig. 8. Bottom view of lowercase modifications.

Plug a 74LS02 into the leftmost socket at A11, making sure the code dot and notch go to the left as shown.

Take a 74LS00 and carefully bend pin 8 so it sticks straight out. Now plug this 74LS00 into location A13, making sure the code dot and notch go to the left as shown.

Carefully remove the 74LS02 in socket B13. Then bend pin 6 of this integrated circuit straight out. Replace this integrated circuit in its socket, making sure the code notch and dot point down toward you, just like all the others in that row.

Prepare a 1-1/4 inch (32 mm) wire by stripping 1/8 inch (3 mm) off each end. This should be a solid wire, preferably #24.

Solder this wire between the two "flying" pins, pin 8 of A13 and pin 6 of B13.

Turn the board upside down and provide the following connections, each time picking a reasonable length of wire and stripping 1/8 inch (3 mm) from each end. When soldering to existing pads, butt the wire against the pad after tinning it. Do not place the wire beside the pad where it can contact the next pad over. *Note that integrated circuit pins count clockwise from the foil side.* See Fig. 8.

Ground wire 7/A11 to 7/A13 to ground at green capacitor A14. *Do not connect to the wide foil.* Connect only to the capacitor lead.

+5 supply wire 14/A11 to 14/A13 to +5 at green capacitor A14. *Do connect to wide foil.*

ASCII bit 6 output wire 23/A5 to 1/A11.

Short bare jumper 2/A11 to 3/A11 to 4/A11.

Short bare jumper 5/A11 to 13/A11.

Short bare jumper 6/A11 to 10/A11.

DL5 input wire from 22/A5 to 11/A11 and 12/A11.

DL6 from 5/B8 to 9/A11 to 9/A13. Be very careful finding 5/B8. Note the square foil pad on all pin 1s of the integrated circuits.

DL7 from 7/B8 to 8/A11 to 13/A13 and 14/A13.

Short bare jumper 10/A13 to 11/A13.

Inspect all the previous connections for possible shorts against adjacent pins.

Remove the character generator A5 from the computer and store it in protective foam. If you have no other foam, use the other side of the foam holding module A.

Plug module A into A5 so that the notched corner is located at A4. See Fig. 9.

Vigorously shake the board to make sure no wire ends remain on the board. This completes the actual modifications.

Gently place the board back onto the nylon supports on the computer bottom. Press down till each barb grabs its portion of the circuit board.

Replace the 6-32 washer and nut in the center of the board.

Plug the power supply connector and the speaker back into their respective sockets.

Set the top back onto the computer.

Gently lift the top and plug in the keyboard connector at location A7, KEYBOARD. Make sure that pin 1 aligns with the white dot, that no pins are bent and that no pins stick out either end of the socket. Check the keyboard end of this ribbon cable to make sure it is also firmly seated.

Reconnect the rf modulator to the 4-pin VIDEO connector if you have one.

While you are firmly holding the top and bottom of your computer together, carefully turn it upside down onto the rug or foam pad on your bench.

There is a metal hook at the back of the computer. Make sure this hook goes into its matching slot in the plastic top (Fig. 6).

Replace the rear-most two Phillips screws. Do not tighten completely. Note: These are flathead screws without washers.

Replace the center-front two Phillips screws. Do not tighten completely. Note: These are binder screws with lock washers.

Replace the remaining two binder head screws at the front.

Replace the remaining four flathead screws, two on each side.

Tighten all screws.

Replace the game paddles, rf output leads, I/O cards and I/O connectors, exactly as you found them.

Replace the cover. Tuck the front end under the top of the computer and then carefully align the cover. Then press firmly down with the heel of your hand, first at left rear, then at right rear, until the Hedlok fasteners snap into place.

Replace the video and cassette connectors.

This completes the modification of your Apple II to lowercase.

Initial Checkout

Check your modification to make sure it is working:

Switch the computer to off and then plug it in.

Very briefly switch the computer on and then back off again. The power supply should click only once, and the POWER light should come on. If the power supply continuously clicks or if the POWER light doesn't come on, you have a short somewhere. Backtrack to find out where.

Now switch the computer on only long enough to press the RESET key. The speaker should beep. If the speaker does not beep, stop to find out why.

Check out your display with an integer BASIC program of some sort. You should have a completely normal display, all uppercase and white on a black background. Some of the punctuation may be slightly different, such as larger periods and commas than before.

Load and run the integer BASIC lowercase test program (see next page). All the letters should appear as lowercase on the lower line, repeating over and over again. Numerals and punctuation should appear normally. As this is a simple test program

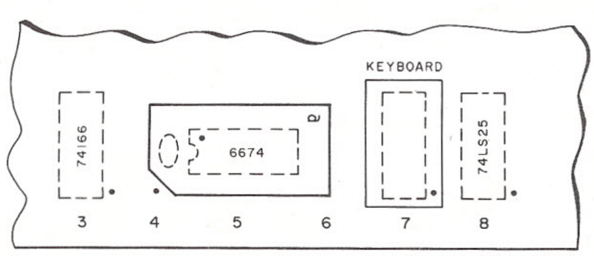

Fig. 9. Correct positioning of module A.

used for debugging, don't worry about the missing cursor or the lack of scrolling.

Type a CTRL A. You should get a capital letter A. Type a CRTL B. You should get a capital B.

Type a CTRL C. What happens? Why?

This completes your checkout. Should you have problems, isolate the trouble to the likely area. For instance, if you can't light the POWER lamp or if the power supply overload relay continuously clicks, look for shorts caused by not-floating pins 1 and 12 of module A, solder blobs or two-pad shorts or integrated circuits plugged in wrong. Note that an *unconnected* power supply will also continuously click.

Your module A generates the characters for you. It receives its lowercase control signal from A11. The screen reversal inhibiting is done by A13. Should you run into trouble, isolate the problem to the source.

If you want to get back to uppercase only, just put the old character generator back, remove A11, A13 and B13 and then put the new or straightened-out 74LS02 back in slot B13. If you are an old pro at PC work, you can put the topside wire on the bottom by cutting the foil going to pin 6 of B13. This is not recommended till after you have debugged your lowercase.

In part 2, we will examine the software development that calls for the lowercase when it is needed. We will also consider further hardware modifications, including adding a switch to give you a choice of reverse screen or lowercase. ■

```
100  FOR CURS = 2000 TO 2039
110       CHAR = PEEK ( - 16384): IF CHAR<127 THEN 110
120       POKE ( - 16368),0
130       IF CHAR>192 THEN CHAR = CHAR - 160
140       POKE CURS,CHAR
150       NEXT CURS
160  GOTO 100
```

A lowercase test program that puts lowercase characters on the bottom display line. Numerals and punctuation appear normally. Use this program for hardware checkout. CTRL-C restores normal BASIC operation.

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- Translation
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- Curve routines providing for situations where known quantities are intersecting lines, three points on a curve, point of curvature, radius point, point of intersection, and point of tangency.

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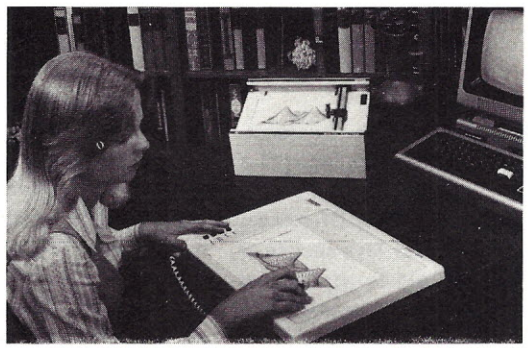

HARDWARE

PERTEC FD 200	$450
TI 810 PARALLEL	1945
16K RAM (NEC 4116)	110
NEC 5530	2700
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What's New in Memory?

Magnetic bubbles are only the beginning; even more memory exotica is on the way.

David Zacks
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Surrey, BC, Canada, V3T 3R1

One of the main considerations in the purchase of a microcomputer is the amount of memory to be used. Of course, the memory is always spoken of in terms of RAM, for storing and developing your programs. However, because of the new memory breakthroughs, soon you will be called on to decide both the amount and type of memory to store and develop your programs. If you are tired of loading an often-used program into your micro, you will be interested in the following discussion.

Magnetic Bubble Memories

Picture this: a memory that can store 125K bytes, is only a few centimeters long, has a fast access time and, best of all, is nonvolatile. If you think that only a disk system can fulfill these options, you're wrong! The answer is one of the newest and most promising memory devices to come along in some time: magnetic bubble memory. Magnetic bubble memories are so different from semiconductor memories that the best way to understand them is to start at the beginning.

In 1967, a scientist at Bell Telephone Laboratories, Andrew H. Bobeck, discovered some unusual effects in a thin wafer of magnetic garnet. Under normal conditions, about half of the wafer is polarized into upward-pointing sections, or domains, and the other half is polarized into downward-pointing domains. This pattern can be observed through a polarizing microscope, since the upward domains rotate light waves in a different direction than downward domains.

Upon placing a small magnet near the garnet wafer, Bobeck discovered that the domains contracted into tiny cylinders that, when viewed end on, looked like bubbles. Magnetic bubbles repel each other, and this keeps a minimum separation. Small, local changes in the magnetic field will cause these bubbles to move. Both these factors help to make magnetic bubbles suitable for a memory system. (See Fig. 1.)

The package that contains the bubbles also contains a rotating magnetic field, produced by a coil. This field aids generation and production of the bubbles. A bubble in the memory can represent a logical 1, and the lack of a bubble a logical 0.

For each full rotation of the field, a bubble is produced. Since we may not need all those bubbles (if the memory is not being written into, for instance), we need something to erase them. A miniature electromagnet, called a bubble-eater, zaps unwanted bubbles with a magnetic field, which erases them by making them disappear.

Arrays of tiny T- and bar-shapes, made of permalloy and other magnetic material, are laid down on the surface of the garnet wafer. As the field rotates, a bubble sitting under a T-shape is repulsed by it, and the nearby bar-shape attracts it. When the field switches 180 degrees, the bar repulses it, while the next T-shape attracts it. All the bubbles thus move down the line of Ts and bars.

A key feature of bubble memories is that stored information is retained when external power is interrupted, a valuable property that will find many useful applications in business and hobby computing. The polarization of the bubbles is protected by using a permanent magnet to maintain a steady magnetic field.

Bubbles stored in a bubble memory are detected, most naturally, with a bubble detector. This consists of a thin film of metal. When a bubble flows underneath the film of metal, the phenomenon of magnetoresistance causes a small amount of current to flow through the film. This can readily be amplified for use with information processors outside the memory.

Bubble memories are inherently serial in organization, since they must search through a stream of bubbles to find a selected chunk of them. Because of this fact, bubble memories cannot compete with random-access electronic memories in speed.

The potential market for magnetic bubble memories lies in the replacement of tape and disk memories with a capacity of between one and ten million bits. In such applications, semiconductor memory can be ruled out because the information stored in them is volatile. Produced in quantity, the cost per bit of storage in bubble memories and moving-surface memories is about the same up to 10 million bits. Over this, moving-surface memories still

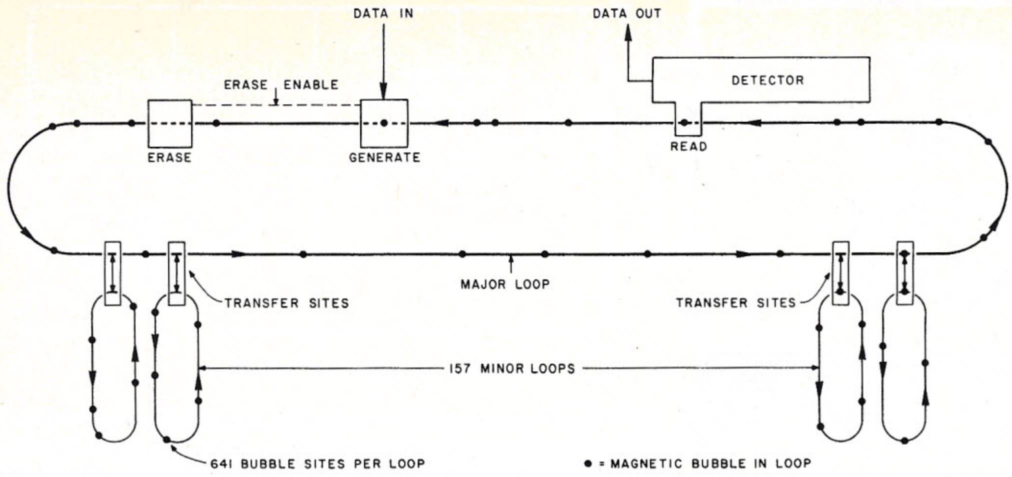

*Fig. 1. Magnetic bubble memory pattern of circulation in the 100,637-bit memory. The major loop holds a single data block consisting of a pattern of 1s and 0s (bubbles or no bubbles) that are being written, read or erased. In this particular device, the data block contains 157 bits. In the write cycle, the 157 bits first enter the major loop, whence they are transferred simultaneously—at a signal—to the 157 minor loops, one bit per loop. Each minor loop, in turn, provides sites for 641 bubbles. Thus, total capacity of the device is 157*641, or 100,637, bits. In the read cycle, 157 bits are transferred simultaneously—at a signal—from minor loops to the major loop, which carries them past the read head. They are then transferred back to their respective loops.*

have a major cost advantage.

A promising variation of the magnetic bubble memory is the bubble-lattice file, or structureless bubble circuit. This variation eliminates the requirements for two patterned-surface electrodes per bit of binary data. The successful development of bubble-lattice memories would overcome the limits imposed by the techniques of defining Ts and bars, which now determines the maximum storage density (about one million bubbles per square inch).

Magnetic bubble memories are a natural for applications where permanence of storage and portability are desired. Programmable calculators, data loggers, voice storage ("You have reached a disconnected number; this is a recording."), measuring and test equipment are just a few examples for the uses of this new technology. In fact, Texas Instruments has now produced a pair of memory data terminals, each with 20K bytes of bubble memory storage, expandable to 80K bytes. Any bit can be selected in four milliseconds.

Of course, bubble memories are expensive now, but this is the case with any emerging technology (remember the $100 four-function calculator?). As competition between various companies heats up, prices will be forced down as a consequence. It is questionable, however, that magnetic bubble memory systems will ever completely replace the floppy disk, as one drive can be used with an unlimited number of disks. Therefore, one drive has an unlimited storage capacity.

Charge-Coupled Devices

Another promising device to come down the technological pipeline is the charge-coupled device, or CCD. The CCD memory consists of thousands of tiny metal squares, each one capable of storing an electrical charge. Like the bubble memory, access to stored bits is serial. Each bit stored is transferred sequentially through all the memory locations before it becomes available for reading. Even so, access times are on the order of 500 microseconds, which is faster than magnetic bubble memories.

There are several reasons why CCD memories can be designed to have a smaller total area per bit of information stored. This means that CCDs are potentially less expensive than random-access semiconductor arrays.

The main reason why CCDs are both smaller and less expensive than RAMs is that a tiny square of metal holds the bit instead of a flip-flop, thus requiring about one fourth the area of silicon. Also, fewer decoding devices to select individual locations are needed, thus reducing the number of chips needed. The net result of these simplifications is that the total silicon area for storage of a single bit has been reduced by approximately a factor of four, compared to a RAM.

Texas Instruments now has a 65K CCD memory on a single chip measuring 3.5 millimeters by 5 millimeters. (See Fig. 2.) This memory can be searched at a rate of 5,000,000 bits per second. Prices are high, too, for the charged-coupled device memory, but prices are expected to tumble when new, higher-density CCDs become available. (See Fig. 3.) The big disadvantage of CCDs, however, is that the information stored is volatile. The CCD requires a constant, though small, amount of current to retain its contents.

There are many applications where serial access for stored information is entirely satisfactory. For example, the memory used to refresh the information presented in a conventional video display, which is scanned point by point, does not require a memory with random access.

On the Horizon

Newer, even more exotic memories are being developed. Although in the research stage, electron-beam memories are expected to store huge quantities of information in a small space,

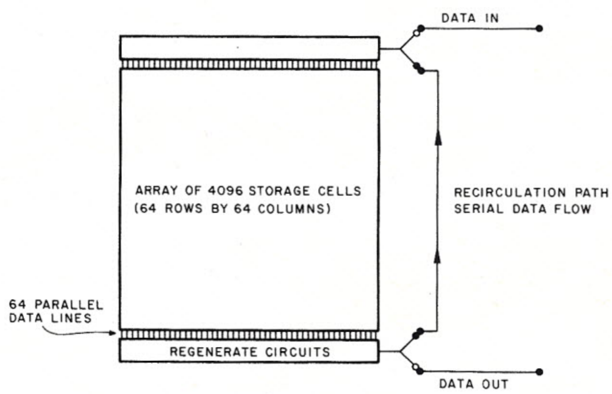

Fig. 2. CCD memory. A single array of 4096 storage cells. Sixteen such arrays make up the 65,536-bit memory mentioned in the text. This diagram shows the circulation of the 4096 bits stored in the memory. The 64 bits stored in each of the 64 columns shift downward synchronously into the regenerator along parallel lines at a rate of 80,000 bits per second. The 4096 bits flow out of the regenerator at a rate of 64 times higher (about 5,000,000 bits per second) in a serial format. The bits reenter the top of the array, distributed along 64 parallel lines into their original columns. Since all 16 arrays operate in this way, the entire CCD is similar to a 4096-bit serial shift register operating at 5,000,000 cycles per second. Since the bits in all the arrays are circulating continously and synchronously, the time required to access any of the 65,536 bits is set by the circulation time of the 4096 bits in any one array. The average access time is .5 milliseconds.

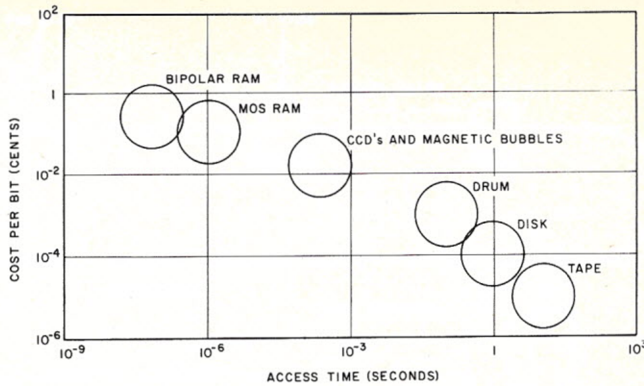

Fig. 3. Access time vs price comparison of various popular memory technologies. CCD and magnetic bubble memory systems are filling the gap between high-speed semiconductor memories and slower-moving surface memories. Cost for all memory systems has already decreased dramatically, and this trend is expected to continue. This means that the cost for all memory devices should drop by a factor of 10 in the next 10 years.

with a fast access time. And speaking of fast access time, experiments are being carried out with both logic and memory chips that will have an on-chip delay of about half a nanosecond.

Laser, hologram and high-resolution microfilm also hold promise for memories in the not-too-distant future. Already, a Dallas TX photography firm has recorded 1500 pages of a King James Bible on a glass plate about half the size of a dime.

It will be years before these fantastic memories become available on the market, but when they do, they will give the memory explosion a push such as the magnetic bubbles and CCDs are doing now.

Archival Memory

Archival memory is perhaps the most fantastic (and one of the most expensive) mass-storage devices yet invented. Invented by the Precision Instrument Company, it is classed as a high-capacity secondary memory. This mechanism can store an incredible *trillion* bits, with an average access time of five seconds. That is about 850 bytes for every man, woman and child in the United States!

The beam from an argon laser records binary data by burning microscopic holes in a thin film of metal coated on a strip of polyester sheet. The strip of metalized polyester, called a data strip, is read and written by being carried on a rotating drum. Each data strip can store 2.9 billion bits—the equivalent of 625 reels of standard magnetic tape—in less than one percent of the volume.

A "strip file" provides storage of 400 data strips, thus allowing access to about 145 billion bytes on-line. The time to access data on any data strip in the file is about five seconds. Within the same strip, data can be located in 200 milliseconds. The read-and-record rate is about 4,000,000 bits a second.

Obviously, the price and capabilities of this system are far beyond the budget and needs of any computer-hobbyist or time-sharing system. I mention this memory device here in the interest of keeping the computer enthusiast up to date on the newest mass-storage devices.

All the memory systems mentioned in this article have certain advantages (speed, capacity or nonvolatility) over one another. Of course, none of these memories can be expected to be all things to all people.

Despite this, however, memories such as CCDs and magnetic bubbles can and will undergo a huge increase in popularity in the next few years. In the next 10 to 15 years, all memory systems are expected to undergo a price reduction of an order of magnitude per bit of data stored. ■

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Reader Service—see page 227

Stringy Floppy Encore

Last month we reviewed the 6800/S-100 Stringy Floppy. This month—the TRS-80 version.

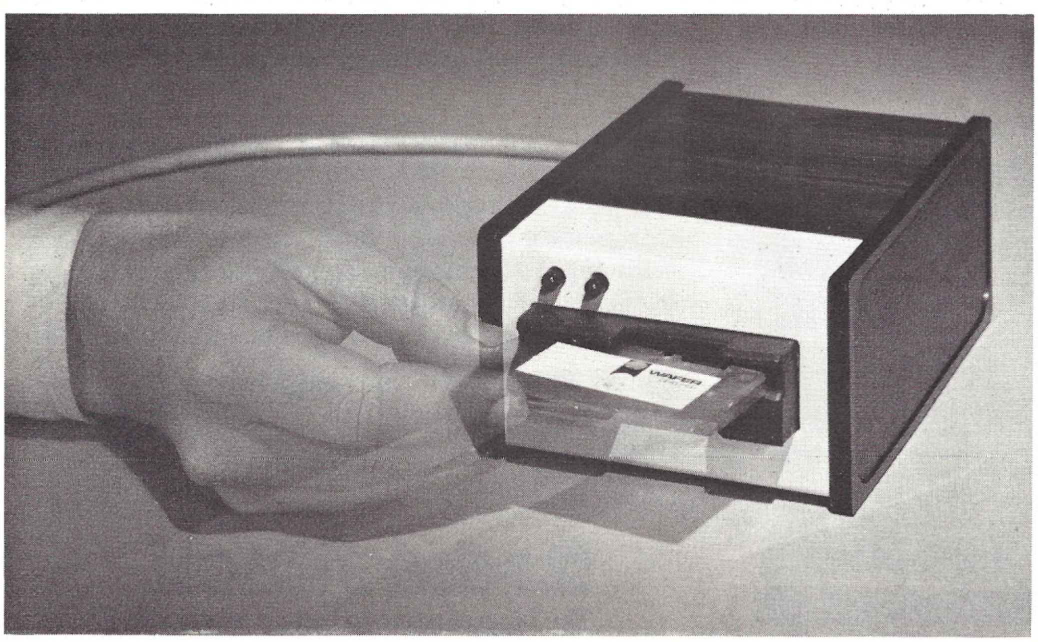
Jim Perry
Microcomputing
Projects Editor

The Exatron Stringy Floppy has been available for some time, for 6800 and S-100 systems, but a version designed for the Radio Shack TRS-80 has only recently been developed. A review, by Bill Harvey, of the 6800 version appeared in the October 1979 issue; this month we review the TRS-80 version, identical mechanically—but even easier to use as all the software needed is in a 2708 EPROM built into the Stringy Floppy itself.

For the benefit of those readers who missed last month's article, a short description of the Stringy Floppy mechanics is in order. The biggest drawback in using any small computer system is the data storage medium, an audio cassette recorder of dubious reliability and performance. If God had intended cassette recorders to store computer data He (or She?) would have given them far greater bandwidth, as the only way to store programs and data on an audio cassette is to do it very slowly—with your fingers crossed. Another alternative is to use a floppy disk unit, which will record and retrieve data orders of magnitude faster than any cassette-based system, but the cost is also orders of magnitude greater. The third way is to use a Stringy Floppy, nearly the speed of a floppy disk at nearly the cost of a cassette recorder.

The basis for the Stringy Floppy is an endless-loop magnetic tape contained in a housing about the size of one of the new micro-sized dictating cassettes (approximately half the size of a normal cassette). This whole unit is called a "wafer"; they come with 5, 10, 20 or even 50 feet of tape inside. Obviously, the longer the tape the more data the wafer can store; with 5 feet of tape, the wafer can hold a 4K BASIC program. Because the device is specifically designed for computer use, it can record information much more densely than an audio system modified for use with computers. Technically inclined readers will be interested to learn that the data is encoded with parity bits and uses a bi-phase self-clocking technique. What this means to nontechnical readers (and all users) is amazing reliability!

Because the unit is designed for a specific purpose it is not suitable for use in the house or office (unlike the normal cassette recorders, which can be used as ordinary cassette recorders), but as a direct result, there are no superfluous controls or knobs—in fact, there are *no* controls or knobs, just two red lights to indicate what the unit is doing. All control is under software instruction, so making mistakes is difficult (how many programs have you saved without pressing the record button?).



The exterior of a Stringy Floppy. *(Photograph courtesy of Exatron)*

Checking It Out

Connection of the Stringy Floppy to the TRS-80 is easy—it just plugs into the back of the keyboard. Multi-way adapter cables are available for systems that need additional devices plugged into the keyboard (screen printers, etc.). After powering-up the system, enter the SYSTEM command, followed by the instruction /12345. In a twinkling of an eye the display comes up with 'EXATRON STRINGY FLOPPY VERSION 3.1', the software for its operation having been patched into the Level II operating system. As far as BASIC is concerned, it now has three extra commands: @NEW, @SAVE and @LOAD.

All the new commands are suffixed with a single digit in the range 1 through 9. This enables selective erasing of old data and

storage of up to nine separate programs per wafer. The @NEW command writes a regular pattern on the wafer, and then reads it back to verify the integrity of the wafer. If a suffix is not used, the software defaults to a 1 and writes over the whole wafer. If a suffix is used, then the file named and all files after it are deleted. For example, on a wafer with eight files, the command @NEW5 erases files 5, 6, 7 and 8.

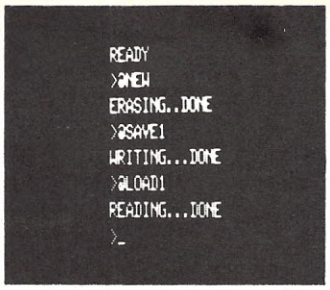
The @SAVE command is the Stringy Floppy's equivalent of CSAVE—it always needs a suffix digit. When executed, the program in memory is written to tape, then the wafer is read back and compared to the program still in memory . . . automatic verification! One thing to watch is that no file numbers are missed out; this causes the unit to hang up.

If you have three files on a wafer, and want to save a fourth, you must use @SAVE4. For example, if you asked the computer to @SAVE6, with only three files existing, the software would continue to search for the end of file 5—and never find it . . . instant hang-up. As a result you must always keep a record of what files are on each wafer; filing cards are ideal.

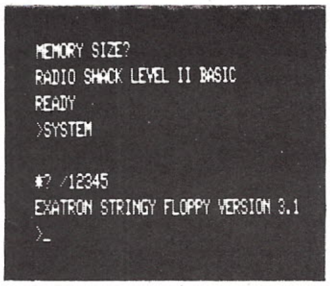
The @LOAD command is the Exatron equivalent of CLOAD, with no buttons to press. If no number is specified, then the next file encountered is loaded; if a file is specified, then the specified file is loaded. If you ask for a nonexistent file, the unit will continue to search as with the @SAVE hang-up. The only way out of both these conditions is to press the BREAK key and try again, so it really is important to keep a record of each wafer's contents.

Both the @SAVE and @LOAD commands use parity bits on each byte of data and a checksum for the entire file. There are only four error messages from the software, but they are spelled out in full. When you use the @LOAD command, PARITY ERROR indicates that one or more bits of data are incorrect—try again. CHECKSUM ERROR also indicates that some of the data is corrupt—try again.

In my six weeks' use of the unit, neither of these messages ever appeared; every load was good. When I used @SAVE, only two messages ever turned up: TAPE TOO SHORT, when a program was far too long for the space left on the wafer, and WRITE PROTECTED, when the reflective disk had been removed to protect a wafer. The reflective disk is the Stringy Floppy's main safeguard against erasure of wanted files, without it the unit will not @SAVE or @NEW the wafer.



The Stringy Floppy sign-on message.



All the commands can be seen in this photograph.

Comparison between the wafer and a conventional cassette.

Data and Assembly Language

For the intrepid assembly-language programmer, the Stringy Floppy has five operations, found between locations 3000 and 3780 (hex), that can be accessed. These are covered fully in the operating manual that comes with the unit. Briefly, address 3000 is the location of the wind-tape-to-beginning subroutine, 3003 is the start of a read-data routine but needs certain other information specified to read data. 3006 is the routine to write data; two registers must contain data length and load location. Address 3009, when called, will write an end-of-data mark, and 300C is for writing data files onto a wafer. BASIC programs and data cannot be mixed on the same wafer.

Wrap-up

If you consider the cost (around $250) and the speed (4K load in seconds), the Exatron Stringy Floppy seems to be a useful addition to the expanding range of TRS-80-related products. In the six weeks that I used the unit, not once did any data/program material misload or become corrupted; reliability was excellent.

The unit comes with a comprehensive instruction manual, one-year warranty and, best of all, a 30-day, unconditional, money-back-if-not-happy guarantee.

Exatron Corporation, 3555 Ryder Street, Santa Clara CA 95051. ■

The Electronic Librarian

Searching for an elusive magazine article or other information can be a frustrating and time-consuming endeavor. This ambitious BASIC-E program makes the task an easy one.

Joseph Jay Sanger, M.D.
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NYC NY 10016

This program represents an interesting and, yes, even useful application of a personal computer: a system for cross-indexing journals, magazine articles or other information. As a resident in radiology, I wanted to develop this system to cross-index the many radiology and nuclear medicine journals I had accumulated. Of course, this idea is not a new one—any reasonable medical library will provide access to a computerized search system—but the convenience of having this facility within one's own home, coupled with the benefits of individually customizing the system, make it a worthwhile project.

I originally conceived of this project in 1975 while I was a medical student, but realistic implementation had to await the introduction of a viable mass storage device, i.e., floppy disks, to my system. But it also needed a spark, which was supplied by Frederick La Plante, Jr.'s lucid article, "Random Files Illustrated," published in the February 1978 issue of *Interface Age*. Until reading this article, I must admit that random files were a mystery to me. However, using his article as a guide, I have succeeded in producing a reliable, convenient and easily customized method of storing, organizing and retrieving information. I believe that many people will be interested in implementing a similar system for their own use.

That this particular package is a Radiology Journal Library is almost incidental; the system is actually quite flexible and can be tailored for almost any situation requiring organization and retrieval of information. In fact, I have also implemented a Personal Computer Article Library with little modification of the program code. And there is no reason why the information to be organized need be written material at all—patients, legal cases, business accounts, etc., all can be organized and cross-linked along suitable common relationships.

The system was written using BASIC-E, a CP/M-based compiler, primarily for its ready availability, simplicity of disk I/O coding and relative speed of operation. However, the system could be implemented, with relatively minor changes, on any disk-based BASIC computer supporting random access files.

My system includes an Imsai 8080 with 40K of RAM, 4K of EPROM, a Processor Technology VDM-1, a Dynabyte Naked Terminal, two Digital System dual-density floppy disk drives and a DEC LA-36 II printer. However, the universal nature of the CP/M operating system ensures the transportability of the system into any other hardware environment, providing it too uses CP/M.

The Key to the System

The key to the system is, literally, the key. In order to conserve disk space and minimize search time, I designed a keyword system. I will illustrate the keyword system with an example. Let us assume that we wish to place into the library file a hypothetical acticle, "New Techniques in Pulmonary Angiography," from the radiology journal, *Radiology*.

Let us further assume that we wish to cross-index this article, that is, make the article accessible under the following six categories: Heart, Lung, Angiography, Diagnosis, Catheterization and Technique. If we were to tag onto the disk record the strings HEART, LUNG, ANGIOGRAPHY, DIAGNOSIS, CATHETERIZATION and TECHNIQUE, not only would we increase the size of the record by 53 bytes (the number of characters in the six items), but the time necessary to select this article from the library would be enormous; each associated cross-index would have to be compared,

AC + 0B + HX + BD + FT + L0→AC0BHXBDFTL0

Example 1.

character by character, until a match was made.

Instead, I have given each of the above cross-indices (and many others) a unique two-letter code based on a base 26 system using the letters A through Y and the single digit 0. To associate the above keys with the corresponding article, I merely create a keyword composed of the concatenation of the six individual keys as shown in Example 1.

As a result, instead of taking up 53 bytes in the file, the keyword only uses 12. The savings are even greater if more than six keys are used. (When multiplied over the entire size of the library file, the savings are actually enormous!) In addition, the retrieval process is greatly expedited via the use of keywords. In order to select articles dealing with angiography, the two-element string HX is all that need be matched in any given record.

But perhaps the greatest benefit to be derived is that a keyword system allows implementation of a core-resident index to further expedite the selection process (described more fully below).

Astute readers will note right away that there is a penalty to pay in using a keyword system. In order to encode the various cross-indices into keys, we must predefine and thereby limit the number of allowable indices, in this case to 26 × 26 = 676 (0A through ZZ). But what is lost in scope is almost certainly made up in compactness and speed. (Actually, 676 different keys should be more than sufficient for any feasible application!)

In order to further save space within the file, the journal name and publication date are encoded in a similar fashion and saved as a two-character and a four-character string, respectively.

The library file (named RADIDATA.LIB) consists of a series of 128-byte records, each record representing a separate entry. A record contains six variables, each automatically enclosed in quotes and separated by commas by BASIC-E.

Sample run.

```
                    SAMPLE OPERATING SESSION

RUN JOURNAL
BASIC-E INTERPRETER - VER 2.3

              ----------------------------------------
              : RADIOLOGY JOURNAL RETRIEVAL SYSTEM :
              ----------------------------------------

                        Please Stand By . . . .

              ----------------------------------------
              : RADIOLOGY JOURNAL RETRIEVAL SYSTEM :
              ----------------------------------------

         Size of Library is currently 91  Entries

Command:? S

Key:? BRAIN
Key:? NEOPLASM
Key:? CT
Key:? 0
If you want Hardcopy, type 'YES' and CTRL-P;
Otherwise type 'NO'? NO
--------------------------------------------------------------

    Library Search for Articles Related to:

              - BRAIN
              - NEOPLASM
              - CT

1 .   RADIOLOGY        EXTRA-AXIAL POST FOSSA LESIONS
                       SIMULATING INTRA-AXIAL LESIONS ON CT
      June 1978        by MILLER & NEWTON
      Page 675

2 .   RADIOLOGY        COMPUTER TOMOGRAPHY IN
                       CRANIOPHARYNGIOMAS
      June 1978        by FITS, WORTZMAN, HOLGATE ET AL
      Page 87

3 .   RADIOLOGY        EVALUATION OF EPENDYMAL AND
                       SUBEPENDYMAL LESIONS BY CRANIAL CT
      May 1978         by OSBORN ET AL
      Page 397

4 .   RADIOLOGY        TUBEROUS SCLEROSIS
      May 1978         by LEE & GAWLER
      Page 403

--------------------------------------------------------------

Command:? S

Key:? STOMACH
Key:? TUMOR

    Invalid Key

Key:? NEOPLASM
Key:? 0
If you want Hardcopy, type 'YES' and CTRL-P;
Otherwise type 'NO'? NO
--------------------------------------------------------------

    Library Search for Articles Related to:

              - STOMACH
              - NEOPLASM

1 .   RADIOLOGY        FILIFORM POLYPOSIS
      June 1978        by ZEGEL & LAUFER
      Page 615

--------------------------------------------------------------

Command:? A
                  (Room for approximately 280  Entries remains)

Journal:? RADIOLOGY
Date:? APR78
Page Number:? 3
Title:? EVOLUTION OF BASIC CONCEPTS UNDERLYING RADIOTHERAPY FROM 1949-1977
Author:? FLETCHER
Key:? RADIOLOGY
Key:? THERAP@YY@Y
Key:? HISTORY
Key:? 0
                  (Room for approximately 270  Entries remains)

Journal:? RADD
Date:? APR78
Page Number:? 21
Title:? FALSE ANEURYSMS OF THE LEFT VENTRICLE
Author:? HIGGINS/ LIPTON/ JOHNSON ET AL
Key:? HEART
Key:? ANEURYSM
Key:? SURGERY
Key:? TRAUMA
Key:? VASCULAR
Key:? INFARCTION
Key:? NECROSIS
Key:? ANGIOGRAPHY

              That is all the Keys Allowed

                  (Room for approximately 270  Entries remains)

Journal:? 0
              ----------------------------------------
              : RADIOLOGY JOURNAL RETRIEVAL SYSTEM :
              ----------------------------------------

         Size of Library is currently 93  Entries

Command:? S

Key:? ANEURYSM
Key:? 0
If you want Hardcopy, type 'YES' and CTRL-P;
Otherwise type 'NO'? NO
--------------------------------------------------------------

    Library Search for Articles Related to:

              - ANEURYSM

1 .   RADIOLOGY        EXTRA-AXIAL POST FOSSA LESIONS
                       SIMULATING INTRA-AXIAL LESIONS ON CT
      June 1978        by MILLER & NEWTON
      Page 675

2 .   RADIOLOGY        B-MODE ULTRASONOGRAPHY OF PROSTHETIC
                       VASCULAR GRAFTS
      June 1978        by GOODING, HERZOG ET AL
      Page 763

3 .   RADIOLOGY        2-D ECHOAORTOCARDIOGRAPHIC APPROACH
                       TO DIS ANEURYSMS OF AORTA
      May 1978         by MATSUMOTO ET AL
      Page 491

4 .   RADIOLOGY        FALSE ANEURYSMS OF THE LEFT VENTRICLE
      April 1978       by HIGGINS, LIPTON, JOHNSON ET AL
      Page 21

--------------------------------------------------------------

Command:? C

What is the Number of the entry to be Changed
  (Obtained from the most recent Search)? 1
```

```
Is this the correct entry:

1 .   RADIOLOGY           EXTRA-AXIAL POST FOSSA LESIONS
                          SIMULATING INTRA-AXIAL LESIONS ON CT
      June 1978           by MILLER & NEWTON
      Page 675

? YES
Here are the Keys for this entry:

BRAIN                NEOPLASM             CT
ANEURYSM             POSTERIOR FOSSA

What Item to be Changed? KEY
Add, Change or Delete a Key:? A
What is the Key:? HEAD
What Item to be Changed? 0
Here is the updated entry:

1 .   RADIOLOGY           EXTRA-AXIAL POST FOSSA LESIONS
                          SIMULATING INTRA-AXIAL LESIONS ON CT
      June 1978           by MILLER & NEWTON
      Page 675

Here are the Keywords:

BRAIN                NEOPLASM             CT
ANEURYSM             POSTERIOR FOSSA      HEAD

Do you want to: A bort the edit, C hange another item,
or are you D one? D

             ----------------------------------------
             ! RADIOLOGY JOURNAL RETRIEVAL SYSTEM !
             ----------------------------------------

          Size of Library is currently 93  Entries

Command:? X

Commands:
---------
A dd an entry
C hange an entry
D elete an entry
F orm a new Index
L ist Keys or Journals
Q uit the Library
S earch the Library

Command:? LIST

Do you want a List of Keys or Journals? JOU

AJR                  RADIOLOGY            SIR.
JNM                  SNM                  RCLINICS

Type 'C' to Continue? C

             ----------------------------------------
             ! RADIOLOGY JOURNAL RETRIEVAL SYSTEM !
             ----------------------------------------

          Size of Library is currently 93  Entries

Command:? LIST

Do you want a List of Keys or Journals? KEYS

ANGIOGRAPHY          ARTERIOGRAPHY        ARTHROGRAPHY
ANASTAMOSIS          ANESTHESIA           ANATOMY
AORTA                ARM                  ARTERY
APPENDIX             ANEURYSM             ANKLE
ADRENAL              ALLERGY              ABNORMALITY
AVM                  ATROPHY              ARTHRITIS
ABSCESS              ASEPTIC              ABDOMEN
BYPASS               BILIARY              BRAIN
BREAST               BLADDER              BLOOD
BILE DUCT            BONE                 BARIUM
BRONCHIECTASIS       BACTERIA             BENIGN
BE                   BIOPSY               BRAINSTEM
COLON                COMPUTER             COMPARISON
CATHETERIZATION      CT                   COLONOSCOPY
Type 'C' to Continue? C
CEREBRUM             CHOLECYSTOGRAPHY     CHEST
CYST                 CALCULUS             CALCIUM
COLOSTOMY            CARCINOID            CALCIFICATION
COLITIS              CONTRAST             CERVICAL
COLLAGEN VASCULAR DISEASE
                     CEREBELLUM           CSF
DOSE                 DIAPHRAGM            DYNAMIC
DEVELOPMENT          DIAGNOSIS            DUODENOGRAPHY
DUODENUM             DATA PROCESSING      DYSOSTOSIS
DEATH                DISEASE              DISLOCATION
ESOPHAGUS            EMBOLIZATION         EMISSION
ELBOW                ENDOSCOPY            ENDOCRINE
ECONOMICS            EQUIPMENT            EYE
EAR                  ERROR                EMPHYSEMA
EMBOLUS              EMPYEMA              EDEMA
Type 'C' to Continue? 0

             ----------------------------------------
             ! RADIOLOGY JOURNAL RETRIEVAL SYSTEM !
             ----------------------------------------

          Size of Library is currently 93  Entries

Command:? F
                    Forming a new Index

                 Saving updated Index File
```

```
             ----------------------------------------
             ! RADIOLOGY JOURNAL RETRIEVAL SYSTEM !
             ----------------------------------------

          Size of Library is currently 93  Entries

Command:? SEARCH

Key:? RADIOLOGY
Key:? THERAPY
Key:? 0
If you want Hardcopy, type 'YES' and CTRL-P;
Otherwise type 'NO'? NO

-----------------------------------------------------------------

      Library Search for Articles Related to:

            - RADIOLOGY
            - THERAPY

1 .   RADIOLOGY           EVOLUTION OF BASIC CONCEPTS
                          UNDERLYING RADIOTHERAPY FROM
                          1949-1977
      April 1978          by FLETCHER
      Page 3

-----------------------------------------------------------------

Command:? DEL

What is the Number of the entry to be Deleted
   (Obtained from the most recent Search)? 1

Is this the correct entry:

1 .   RADIOLOGY           EVOLUTION OF BASIC CONCEPTS
                          UNDERLYING RADIOTHERAPY FROM
                          1949-1977
      April 1978          by FLETCHER
      Page 3

? YES

      Entry Deleted from Library

             ----------------------------------------
             ! RADIOLOGY JOURNAL RETRIEVAL SYSTEM !
             ----------------------------------------

          Size of Library is currently 92  Entries
```

Program A. Main Program.

```
REM     RADIOLOGY JOURNAL RESOURCE LIBRARY
REM
REM            MAIN PROGRAM
REM
REM          WRITTEN IN BASIC-E
REM                  BY
REM        JOSEPH JAY SANGER, M.D.
REM
REM
REM             JUNE 12, 1978
REM

CLEAR.SCREEN=12        REM DEFINE SCREEN CLEAR CHAR.
KEYBOARD.DATA.PORT=5   REM DEFINE KEYBOARD DATA PORT
MAX.ENTRY=500          REM DEFINE MAXIMUM SIZE OF LIBRARY
MAX.KEYS=8             REM DEFINE MAX NO OF KEYS FOR AN ENTRY
EOF$=CHR$(26)          REM DEFINE END OF FILE CHARACTER

DIM INDEX$(MAX.ENTRY),MONTH$(12),KEY$(400),JOURNAL$(40)
DIM CODE$(7),K$(MAX.KEYS),SPOOL(MAX.ENTRY)

GOSUB 800        REM SIGN ON MESSAGE
PRINT TAB(24);"Please Stand By . . . .":PRINT:PRINT
```

"02","7801","104","NEW TECHNIQUES IN PULMONARY ANGIOGRAPHY",
"HOROWITZ AND VEIT","ACOBHXBDFTLO,"

Example 2.

These variables represent, in sequence:

1. Encoded journal name
2. Encoded date of publication
3. Page number
4. Title of article
5. Author's name(s)
6. Keyword

A sample record is shown in Example 2.

At all times, an index is kept in the machine RAM space. This index is actually a list of all of the keywords found in the library file, in the exact sequence they appear in the file. It is from this index that selection of articles is made; only afterwards are the appropriate library articles actually retrieved from the diskette in a random access manner. The advantage of this index system is that selection and sorting can take place in RAM at maximal speed, rather than laboriously swapping records to and from the diskette.

One more item should be explained. Rather than constructing this index each time the system is turned on, I have elected to store the index itself as a random access file. Upon turn-on, this index file is read into core, obviating the need to generate the index *de novo* each time and consequently saving considerable time. The name of this index file is "RADIINDX.LIB," which, just like its core-resident image, consists of a linear list of the keywords, such as:

"FHWIXJVKSH5U0S0A"
"DFIEHJF0SKC"
"LDFIUF"
"A0AFLDKGHDKC"
.
.
.
e
t
c

Whenever a change is made to the library file, simultaneous changes are made to the index file and its core image. This ensures compatibility, at all times, between the library file, RADIDATA.LIB, and its index file, RADIINDX.LIB. (As explained under the section describing the FORM command, a new index file can be regenerated at any time, if need be.)

The System

The system consists of three modules. The Main Program Module (Program A), entitled "JOURNAL," contains all routines to create, modify and search the library file. A separate, self-contained Sort Program Module (Program B) named "RADSORT," which will sort the library file by date of publication (not absolutely necessary, but it is nice to have your selected references come out of the file in chronological order), is also provided. The third module (Program C), entitled "KYEXPAND," is a routine that allows you to increase the number of keywords under which data is accessible, without disturbing the integrity of any previously encoded information. Both utility modules are further described below. This separation of function was done because the Sort and Expansion programs use up a fair amount of core that could better be used maintaining larger library files.

Program Commands

Commands may be entered by typing either the whole command word or only the first letter, followed by a carriage return.

ADD—The Add command is used to add an entry to the library file. When this command is entered, a survey is made of the amount of free core currently available, and an estimate is made of the approximate number of additional entries allowable. (Usually, the limiting factor to the size of the library file is the amount of free core devoted to the resident index file, not the amount of space on the diskette.) The computer will then demand user input concerning the entry to be made. A hypothetical example is shown in Example 3, with the computer prompts on

```
REM     READ NECESSARY INFORMATION FROM DATA STATEMENTS

        FOR I=1 TO 100
                READ JOURNAL$(I)
                IF JOURNAL$(I)="0" THEN 10
        NEXT I
10      NM=I-1

        FOR I=1 TO 12
                READ MONTH$(I)
        NEXT I

        FOR I=1 TO 400
                READ KEY$(I)
                IF KEY$(I)="0" THEN 20
        NEXT I
20      NK=I-1

REM             DEFINE FIRST LETTERS OF VALID COMMANDS

        CODE$(1)="A"
        CODE$(2)="C"
        CODE$(3)="D"
        CODE$(4)="F"
        CODE$(5)="Q"
        CODE$(6)="S"
        CODE$(7)="L"

REM             OPEN LIBRARY FILE

        DATALIB$="RADIDATA.LIB": INDXLIB$="RADIINDX.LIB"
        FILE DATALIB$(128),INDXLIB$(2*MAX.KEYS+4)

REM             READ INDEX FILE FROM DISK

        IF END #2 THEN 30
        FOR I=1 TO MAX.ENTRY
                READ #2,I;INDEX$(I)
                IF INDEX$(I)="0" THEN NULL=NULL+1
        NEXT I
30      EXTENT=I-1
        INDEX$(I)="0"
        IF EXTENT>0 THEN 35

REM             ARRIVE HERE IF EMPTY INDEX FILE ON DISK

        INPUT"I can't find an Index File - is this a new Library";A$
        A$=LEFT$(A$,1)
        IF A$="Y" THEN 35

REM             FORM NEW INDEX FILE
31      GOSUB 32
        GOTO 35

32      PRINT TAB(21);"Forming a new Index"
        PRINT:PRINT:PRINT:PRINT

        NULL=0
        IF END #1 THEN 33
        FOR I=1 TO MAX.ENTRY-1
                READ #1,I;DUM$,DUM$,DUM$,DUM$,DUM$,INDEX$(I)
                IF INDEX$(I)="0" THEN NULL=NULL+1
        NEXT I
33      EXTENT=I-1
        INDEX$(I)="0"
        GOSUB 410
        RETURN

REM                     COMMAND MODE ENTRY POINT

35      GOSUB 800       REM SIGN ON MESSAGE
        PRINT TAB(11);"Size of Library is currently ";EXTENT-NULL; \
          " Entries":PRINT:PRINT

40      FOR J=1 TO 1 STEP 0
```

Journal?	RADIOLOGY
Date?	JANUARY 1978
Page Number?	104
Title?	NEW TECHNIQUES IN PULMONARY ANGIOGRAPHY
Author?	HOROWITZ AND VEIT
Key?	LUNG
Key?	ANGIOGRAPHY
Key?	TECHNIQUE
Key?	0

Example 3.

What is the number of the entry to be changed?

Example 4.

the left; the user responses are on the right.

Note: Double quotation marks are never to be included in the title; use single quotes instead. They are not valid characters in a BASIC-E disk file! Also, since BASIC-E does not support a LINE INPUT command, commas are not allowed for any input (title or author). Instead, use a backslash (/); there is a routine built into the ADD section which will convert it to commas on the disk file. Note also that a 0 is typed to end the entry. (Generally, a response of 0 to any computer prompt will return to the Command Mode entry point.)

At this point, the entry will be added to the existing library file on the diskette. The computer will then prompt again for another addition by again typing the query:

Journal?

Additional entries may now be made or a response of 0 will elicit the current count of articles in the library and will return control to the Command Mode.

As mentioned above, both the date and journal name are encoded before being put into the library file. An indirect benefit of this process is that some shorthand is allowed in entering these data. The way this system is set up, the journal name need only be specified by the first three letters of its name, and the date need only be specified by typing the first three letters of the month and the last two digits of the year. An example of this is shown below:

Journal?	RAD
Date?	JAN78

(It should be noted that the names of the various journals in the DATA statements have been abbreviated such that the first three letters are unique for each journal. If it is impossible or awkward to do this in another customized system, the program will have to be suitably altered to scan more than the three characters I have chosen to use.)

CHANGE—The CHANGE command allows you to edit any entry in the file. The computer will prompt you as in Example 4. (The number of the entry is obtained from a SEARCH, as described below.) When the appropriate number is entered, the computer will display the corresponding entry, along with another prompt (see Example 5). If it is not the correct entry, type 'NO' and the computer will remind you that it is now time to:

Conduct another Search and repeat

If it is the correct entry, a 'YES' response will elicit a listing of the associated keys for your persual, followed by yet another prompt:

Here are the Keys for this entry:
LUNG ANGIOGRAPHY TECHNIQUE
What item to be changed?

At this point, several responses are valid:

JOURNAL	(or 'J')
DATE	(or 'D')
PAGE	(or 'P')
TITLE	(or 'T')
AUTHOR	(or 'A')
KEY	(or 'K')
0	return to Command Mode

Further computer prompts are generated as necessary to facilitate the editing process for each of the above cate-

```
            PRINT
            INPUT"Command:";COM$
            FOR I=1 TO 7
                    IF LEFT$(COM$,1)=CODE$(I) THEN  \
                    ON I GOTO 100,200,300,31,400,500,600
            NEXT I

REM     ARRIVE HERE IF INVALID COMMAND WAS ENTERED

            PRINT CHR$(CLEAR.SCREEN)
            PRINT "Commands:"
            PRINT "---------"
            PRINT "A dd an entry"
            PRINT "C hange an entry"
            PRINT "D elete an entry"
            PRINT "F orm a new Index"
            PRINT "L ist Keys or Journals"
            PRINT "Q uit the Library"
            PRINT "S earch the Library"

        NEXT J
        STOP

REM         ADD AN ENTRY TO LIBRARY

        FOR I=1 TO 1 STEP 0

100     PRINT CHR$(CLEAR.SCREEN)
        PRINT TAB(20); "(Room for approximately ";
        PRINT INT((FRE-300)/150)*10;" Entries remains)"
        PRINT:PRINT
101     INPUT"Journal:";MG$
        IF LEFT$(MG$,1)="0" THEN GOTO 35
        EM=0: GOSUB 120
        IF EM=1 THEN 101
102     INPUT "Date:";DATE$
        IF DATE$="0" THEN 35
        ED=0: GOSUB 130
        IF ED=1 THEN 102
        INPUT "Page Number:";PAGE$
108     INPUT"Title:";TITLE$
        IF TITLE$="0" THEN 35
        INPUT "Author:";AUTHOR$
        IF AUTHOR$="0" THEN 35
        FLAG=0:GOSUB 160           REM CHECK LENGTH OF RECORD
        IF FLAG=1 THEN 108
        GOSUB 750        REM      INSERT "," WHERE APPROPRIATE
        FOR J=1 TO MAX.KEYS: K$(J)="": NEXT J
        FOR J=1 TO MAX.KEYS
103         INPUT"Key:";K$(J)
            IF K$(J)="0" THEN K$(J)="": GOTO 105
            EK=0: GOSUB 140
            IF EK=1 THEN 103
        NEXT J
        PRINT:PRINT
        PRINT TAB(18);"That is all the Keys Allowed":PRINT:PRINT

105     GOSUB 110 REM CONSTRUCT KEY VECTOR

REM         FIND FIRST EMPTY SLOT IN FILE

        FOR J=1 TO MAX.ENTRY-1
            IF INDEX$(J)="0" THEN 107
        NEXT J
        PRINT:PRINT"     No more room in Library":PRINT: \
          GOTO 35

REM         WRITE NEW ENTRY TO FILE

107     INDEX$(J)=KY$     REM      UPDATE KEY IN INDEX
        GOSUB 900
REM
REM         IF FILE EXTENT EXPANDS, WRITE NEW EOF

        IF J>EXTENT THEN :\
          EXTENT=J : \
          PRINT #1,(EXTENT+1);EOF$:\
          INDEX$(J+1)="0" :\
```

gories. When the 0 is typed, before returning to Command Mode, the edited entry is displayed, and you are given the option to abort the edit and leave the original entry unchanged, change yet another item or signify that you are satisfied with the changes and are done.

DELETE—The DELETE command is used to simply remove a specified entry from the library file. The prompting is similar to that used in the CHANGE command; the number of the entry is requested, the entry is displayed and upon your OK, the entry is deleted.

FORM—The FORM command is used to form a new index file and core-resident index. This command, ideally, should never be needed. Situations that may require it include a crash of the old index file on the library diskette or when you suspect that the index image in core is not quite kosher; that is, it doesn't accurately correspond to the library file on diskette. (You may suspect this when an entry isn't selected by the keys that have previously been associated with that entry.)

LIST—The LIST command is used to remind you of two things: the names of the journals currently included in the library and the currently acceptable keys. The prompt is:

```
Do you want a List of Keys or Journals?
```

The choice is entered, and the appropriate list is then displayed. (Like all of the outputs in this system, the display is formatted for a 64 × 16 character terminal device.)

QUIT—The QUIT command is merely a graceful exit from the program and a return to the CP/M operating system; all files are closed appropriately and the machine politely says 'Bye'.

SEARCH—The SEARCH command is the way to select entries from the library. It allows a class of articles to be selected on up to eight different keys. Using our example from above, here is how it works:

```
Key?     LUNG
Key?     0
```

The 0 tells the computer that all search keys have been entered (in this case, only one key has been specified). The computer will then reply as in Example 6. This hard-copy option is only available if you have implemented the CP/M LST: device driver and, of course, if you have a printer (CTRL-P refers to control P and is one of CP/M's ways of turning on the printer).

In this example, the Search routine will scan the entire library file, select all articles having the key 'LUNG' associated with them and display them. Of course, more than one key (up to eight) may be specified for selecting classes of more specialized articles. An exam-

```
RADIOLOGY            NEW TECHNIQUES IN PULMONARY ANGIOGRAPHY
January 1978         by HOROWITZ AND VEIT
Page 104
Is this the correct entry?
```

Example 5.

```
If you want hardcopy, type 'YES' and CTRL-P;
Otherwise type 'NO'
```

Example 6.

```
        GOTO 109
        NULL=NULL-1
109     NEXT I

REM             CONSTRUCT SEARCH VECTOR

110     KY$=""
        FOR II=1 TO MAX.KEYS
                KY$=KY$+K$(II)
        NEXT II
        RETURN

REM             ENCODE JOURNAL

120     FOR II=1 TO NM
                IF LEFT$(MG$,3)=LEFT$(JOURNAL$(II),3) THEN 121
        NEXT II
        PRINT:PRINT"          Invalid Journal": PRINT: \
          EM=1: RETURN
121     IF II<10 THEN 123
        MG$=LEFT$(STR$(II),2): RETURN
123     MG$="0"+LEFT$(STR$(II),1): RETURN

REM             ENCODE MONTH

130     IF LEN(DATE$)<5 THEN 130.5
        A$=LEFT$(DATE$,3)
        A1$=LEFT$(A$,1): A2=ASC(MID$(A$,2,1)): A3=ASC(MID$(A$,3,1))
        A2=A2 OR 32: A3=A3 OR 32
        A$=A1$+CHR$(A2)+CHR$(A3)
        FOR II=1 TO 12
                MNTH$=LEFT$(MONTH$(II),3)
                IF MNTH$=A$ THEN 131
        NEXT II
130.5   PRINT:PRINT"          Invalid Date": PRINT
        PRINT: ED=1: RETURN

131     IF II<10 THEN 134
        B$=LEFT$(STR$(II),2): GOTO 136
134     B$="0"+LEFT$(STR$(II),1)
136     DATE$=RIGHT$(DATE$,2)+B$: RETURN

REM             ENCODE KEY

140     FOR II=1 TO NK
                IF K$(J)=KEY$(II) THEN 150
        NEXT II
        PRINT:PRINT"          Invalid Key":PRINT: \
          EK=1: RETURN
150     KK=0
        FOR JJJ=1 TO 26
                IF II<26 THEN 155
                II=II-26: KK=KK+1
        NEXT JJJ
155     IF KK=0 THEN S1$="0": GOTO 157
        S1$=CHR$(64+KK)
157     IF II=0 THEN K$(J)=S1$+"0": RETURN
        K$(J)=S1$+CHR$(64+II)
        RETURN

REM             CHECK LENGTH OF RECORD

160     RECORD.LENGTH=23+2*MAX.KEYS+LEN(TITLE$)+LEN(PAGE$)+ \
          LEN(AUTHOR$)
        IF RECORD.LENGTH < 127 THEN FLAG=0: RETURN
        PRINT
        PRINT "Input is too long - Shorten Title & Author by ";\
          RECORD.LENGTH-126;" characters.": FLAG=1: PRINT: RETURN

REM             CHANGE AN ENTRY

200     A$="Changed": IS=0
        GOSUB 310 REM FIND DESIRED ENTRY
        IF IS=1 THEN 40
        TEMP.POINTER=J REM SAVE POINTER TO RANDOM FILE
        TEMP.INDEX.STORE$=INDEX$(TEMP.POINTER)

        PRINT"Here are the Keys for this entry:"
        PRINT: GOSUB 220   REM PRINT KEYS
```

ple of this is shown below.

Key?	BRAIN
Key?	INFARCTION
Key?	DIAGNOSIS
Key?	TOMOGRAPHY
Key?	AXIAL
Key?	COMPARISON
Key?	RADIONUCLIDE SCAN

Each selected article displayed by the Search command is numbered consecutively, beginning with 1. It is these arbitrary numbers that are referred to when the CHANGE and DELETE commands query "What is the number of the entry . . . ."

The Sort Program Module

For reasons mentioned above, the Sort Program is distinct from the Main Program. The Sort Program will take the library file and sort it in chronological order, from the oldest article through the most recent. It is a sort-in-place algorithm, which means that it alters the original library file—and, as it prudently warns you before beginning, it is wise to have a backup library file on another diskette before sorting (you never know when a power glitch will come along). The Sort Program will also create a sorted index file, as well. To run the Sort Module, merely "RUN-E" it using the BASIC-E run-time package, as with other BASIC-E programs.

I must confess that I am somewhat naive when it comes to programming. This Sort Program, while basically a Shell-Metzner sort (see "A Comparison of Sorts" by John Grillo in *Creative Computing*, Vol. 2, No. 6, Pg. 76), is almost certainly not the most clever or the fastest that could have been written. But it does work. Nevertheless, I would be glad to see someone improve on it and publish a short piece telling us how.

The Expansion Module

The Key Expansion Module ("KYEXPAND") is designed to facilitate an increase in the number of keywords under which the data is organized. The keywords are listed in a series of DATA statements at the end of the Main Program Module. They are listed in a rough alphabetical order (by the first letter only) in order to make the LIST command (described previously) easier to use.

From time to time, you will come across articles (or information) that are not easily classified under the existing keywords or you may merely want to increase the depth of classification by adding additional keywords. Ideally, the additional keywords should be added to the DATA list in alphabetical order. However, this will disturb the correspondence between the key codes in the disk files and the intended keywords.

The KYEXPAND Module, when properly used, will recalculate the key codes, taking into account the newly added keywords, and adjust the codes in both the RADIDATA.LIB and the RADIINDX.LIB files appropriately. The net effect will be proper correspondence between all key codes on the disk and the intended key words.

To properly use the KYEXPAND Module, the following steps should be followed carefully.

1. Make sure that the keyword DATA statements at the end of the KYEXPAND Module and the Main Program Module are *identical*. If they are not, make changes in KYEXPAND Source to ensure identity. (Make sure that the keyword DATA list is the current list.)

2. Add additional DATA statements following the keyword DATA statements, in pairs, containing first the keyword in the list that is to PRECEDE the new addition and then the new keyword (separated by a comma). Terminate these additional DATA statements with a dummy

```
        PRINT
204     INPUT"What Item to be Changed ";A$
        A$=LEFT$(A$,1)
        IF A$<>"0" THEN 205
        FLAG=0: GOSUB 160
        IF FLAG=1 THEN 204
        IF COMMA.FLAG=1 THEN COMMA.FLAG=0: GOSUB 750     REM  REPLACE "/"'S WITH ","'S
        PRINT "Here is the updated entry:":PRINT
        GOSUB 541
        PRINT:PRINT"Here are the Keywords:":PRINT
        GOSUB 220   REM PRINT KEYS
        PRINT
        PRINT"Do you want to: A bort the edit, C hange another item,"
        INPUT"or are you D one ";A$
        A$=LEFT$(A$,1)
        IF A$="D" THEN J=TEMP.POINTER: GOSUB 900: GOTO 35 REM SAVE IT
        IF A$="C" THEN 204
        INDEX$(TEMP.POINTER)=TEMP.INDEX.STORE$
        GOTO 35
205     IF A$="K" THEN 213
        INPUT"What should this item be: ";B$
        IF B$="0" THEN 204
        EM=0
        IF A$<>"J" THEN 209
        TEMP$=MG$: MG$=B$: GOSUB 120
        IF EM=1 THEN MG$=TEMP$
        GOTO 204
209     IF A$="T" THEN TITLE$=B$: COMMA.FLAG=1: GOTO 204
        IF A$="P" THEN PAGE$=B$: GOTO 204
        ED=0
        IF A$<>"D" THEN 210
        TEMP$=DATE$: DATE$=B$: GOSUB 130
        IF ED=1 THEN DATE$=TEMP$
        GOTO 204
210     IF A$="A" THEN AUTHOR$=B$: COMMA.FLAG=1: GOTO 204
        IF A$<>"K" THEN 218
213     INPUT"Add, Change or Delete a Key: ";A$
        A$=LEFT$(A$,1)
        IF A$="C" THEN 214
        IF A$="D" THEN 231
        IF A$<>"A" THEN 218

                REM ADD A NEW KEY

212     J=1: INPUT "What is the Key: ";K$(J)
        IF K$(J)="0" THEN 204
        EK=0: GOSUB 140
        IF EK=1 THEN 212
        IF LEN(KY$)=2*MAX.KEYS THEN \
          PRINT"No more Keywords allowed for this entry": \
          PRINT: GOTO 204

REM             INSERT NEW KEYWORD

        KY$=KY$+K$(J)
        INDEX$(TEMP.POINTER)=KY$ REM UPDATE INDEX LISTING
        GOTO 204

214     J=1: INPUT "Old Key: ";K$(J)
        IF K$(J)="0" THEN 204
        EK=0: GOSUB 140
        IF EK=1 THEN 213

REM     FIND THIS KEY IN KEYWORD
        FOR I=1 TO (LEN(KY$)/2)
                IF K$(J)=MID$(KY$,2*I-1,2) THEN 215
        NEXT I
        PRINT"This keyword not applicable to this entry":\
          GOTO 204
215     INPUT "New Key: ";K$(J)
        IF K$(J)="0" THEN 204
        EK=0: GOSUB 140
        IF EK=1 THEN 215

REM             MAKE CHANGE IN KEY

        IF 2*I=LEN(KY$) THEN K2$="": GOTO 216
        K2$=RIGHT$(KY$,LEN(KY$)-2*I)
```

```
216     IF I=1 THEN K1$="": GOTO 217
        K1$=LEFT$(KY$,(I-1)*2)
217     KY$=K1$+K$(J)+K2$ REM FORM NEW KEY

        INDEX$(TEMP.POINTER)=KY$ REM UPDATE INDEX LISTING
        GOTO 204

REM             DELETE AN EXISTING KEYWORD

231     J=1:INPUT"What is the Keyword to be Deleted: ";K$(J)
        IF K$(J)="0" THEN 204
        EK=0: GOSUB 140
        IF EK=1 THEN 204

REM             FIND KEYWORD IN KEY

        FOR I=1 TO (LEN(KY$)/2)
                IF MID$(KY$,2*I-1,2)=K$(J) THEN 237
        NEXT I
235     PRINT
        PRINT"This Key not applicable to this entry"
        GOTO 204

REM             DELETE THE KEYWORD

237     IF 2*I=LEN(KY$) THEN K2$="": GOTO 238
        K2$=RIGHT$(KY$,LEN(KY$)-2*I)
238     IF I=1 THEN K1$="": GOTO 238.5
        K1$=LEFT$(KY$,2*I-2)
238.5   KY$=K1$+K2$
        INDEX$(JJ)=KY$
        GOTO 204

218     PRINT "Invalid Input"
        GOTO 204

REM             PRINT AN ENTRY'S KEYWORDS

220     FOR II=1 TO (LEN(KY$)/2)
                PRINT TAB((((II-INT((II-1)/3)*3)-1)*20)+1); : \
                  GOSUB 700      REM DECODE KEY
                PRINT KEY$(STRING.NO);
                IF INT(II/3)=II/3 THEN PRINT
        NEXT II
        IF INT(I/3)<>I/3 THEN PRINT
221     PRINT: RETURN

REM             DELETE AN ENTRY

300     IS=0: A$="Deleted"
        GOSUB 310 REM FIND AN ENTRY
        IF IS=1 THEN GOTO 35 REM FOUND WRONG ENTRY
REM     DELETE KEY FROM INDEX

        INDEX$(J)="0"
        NULL=NULL+1

REM     CLEAR ENTRY FROM FILE

        KY$="0": GOSUB 900

        PRINT CHR$(CLEAR.SCREEN)
        PRINT"          Entry Deleted from Library":PRINT
        PRINT:PRINT:GOTO 35

310     PRINT CHR$(CLEAR.SCREEN)
        PRINT"What is the Number of the entry to be ";A$
        INPUT "     (Obtained from the most recent Search)    ";I
        IF I=0 THEN 40
        IF I>NUMBER.SPOOL THEN PRINT:PRINT: \
          PRINT"       Invalid entry number" : \
          GOTO 312
        J=SPOOL(I)
        IF J>EXTENT THEN 312
        PRINT:PRINT"Is this the correct entry:":PRINT:PRINT
        M=I:GOSUB 540 REM PRINT THE ENTRY
        KY$=DUM$
        INPUT N$: N$=LEFT$(N$,1)
        IF N$="Y" THEN RETURN
```

```
513             NUMBER.INDEX.KEYS=(LEN(INDEX$(J))/2)
                FOR I=1 TO NUMBER.SEARCH.KEYS
                        FOR K=1 TO NUMBER.INDEX.KEYS
                                IF MID$(KY$,2*I-1,2) = \
                                  MID$(INDEX$(J),2*K-1,2) THEN \
                                  515
                        NEXT K
                        GOTO 519
515             NEXT I
516             SPOOL(M)=J
                GOSUB 540       REM     PRINT ENTRY
                M=M+1
519     ABORT.FLAG=0
        GOSUB 550       REM POLL KEYBOARD
        IF ABORT.FLAG=1 THEN 520
        NEXT J
520     NUMBER.SPOOL=M-1
        RETURN

REM             CLEAR SPOOL MATRIX

530     FOR I=1 TO EXTENT
                SPOOL(I)=0
        NEXT I
        RETURN

REM             PRINT AN ENTRY

540     READ #1,J;MG$,DATE$,PAGE$,TITLE$,AUTHOR$,DUM$
541     PRINT M;".";
        PRINT TAB(7); JOURNAL$(VAL(MG$));
        PRINT TAB(25);
        IF LEN(TITLE$) < DASHES-26 THEN PRINT TITLE$: GOTO 545

REM             BREAK TITLE INTO MULTIPLE LINES

        TEMP.TITLE$=TITLE$
542     FOR JJ=DASHES-26 TO 1 STEP -1
                IF MID$(TEMP.TITLE$,JJ,1)=" " THEN 543
        NEXT JJ
543     TITLE1$=LEFT$(TEMP.TITLE$,JJ-1)
        TITLE2$=RIGHT$(TEMP.TITLE$,LEN(TEMP.TITLE$)-JJ)
        PRINT TITLE1$: PRINT TAB(25);
        IF LEN(TITLE2$) < DASHES-26 THEN PRINT TITLE2$: GOTO 545
        TEMP.TITLE$=TITLE2$: GOTO 542

545     PRINT TAB(7);MONTH$(VAL(RIGHT$(DATE$,2)));" 19";
        PRINT LEFT$(DATE$,2);
        PRINT TAB(25);"by ";AUTHOR$
        PRINT TAB(7);"Page ";PAGE$
        PRINT
        RETURN


REM             KEYBOARD POLL ROUTINE TO BREAK LISTING
REM                     (TYPE "0" TO ABORT)

550     IF (INP(KEYBOARD.DATA.PORT) AND 127) <> 48 THEN RETURN
        GOSUB 509       REM PRINT LINE OF DASHES
        IF PRINTER.FLAG$ = "Y" THEN 507 REM TURN PRINTER OFF
        ABORT.FLAG=1: RETURN

REM             LIST KEYS AND/OR JOURNALS IN LIBRARY

600     PRINT CHR$(CLEAR.SCREEN)
        INPUT"Do you want a List of Keys or Journals";A$
        PRINT CHR$(CLEAR.SCREEN)
        A$=LEFT$(A$,1)
        IF A$="J" THEN 620
        IF A$<>"K" THEN 35

REM             LIST KEYS

        FOR I=1 TO NK
                PRINT TAB((((I-INT((I-1)/3)*3)-1)*20)+1);\
                  KEY$(I);
                IF INT(I/3)=I/3 THEN PRINT
                IF INT(I/42)=I/42 THEN GOSUB 650
                IF A$ ="0" THEN GOTO 35
```

```
312     PRINT:PRINT"Conduct another Search and repeat"
        PRINT: IS=1: RETURN

REM             QUIT THE LIBRARY

400     PRINT CHR$(CLEAR.SCREEN)
        PRINT TAB(17);"This Session is Terminated ... Bye!":PRINT:PRINT
        PRINT:PRINT:PRINT
        STOP

410     PRINT TAB(18);"Saving updated Index File":PRINT:PRINT
        PRINT:PRINT
        FOR I=1 TO EXTENT
                PRINT #2,I;INDEX$(I)
        NEXT I
        PRINT #2,I;EOF$
        RETURN

REM             SEARCH THE LIBRARY

500     PRINT CHR$(CLEAR.SCREEN)
        FOR J=1 TO MAX.KEYS
                K$(J)=""
        NEXT J
        FOR J=1 TO MAX.KEYS
501             INPUT "Key: ";K$(J)
                IF LEFT$(K$(J),1)="0" THEN K$(J)="": GOTO 503
                EK=0: GOSUB 140
                IF EK=1 THEN 501
        NEXT J

503     GOSUB 110  REM CONSTRUCT SEARCH VECTOR

        PRINT "If you want Hardcopy, type 'YES' and CTRL-P;"
        INPUT "Otherwise type 'NO'";PRINTER.FLAG$
        PRINTER.FLAG$=LEFT$(PRINTER.FLAG$,1)
        PRINT CHR$(CLEAR.SCREEN)
        GOSUB 509  REM PRINT A LINE OF ----'S
        PRINT
        IF KY$<>"" THEN 504
        PRINT TAB(13);"Complete Listing of All Entries"
        GOTO 505
504     PRINT"        Library Search for Articles Related to:"
        PRINT
        FOR II=1 TO (LEN(KY$)/2)
                PRINT TAB(16);"-";
                PRINT TAB(18);
                GOSUB 700       REM  DECODE KEY
                PRINT KEY$(STRING.NO)
        NEXT II
505     PRINT
        GOSUB 510 REM SEARCH INDEX FILE AND PRINT SELECTED ENTRIES
        IF NUMBER.SPOOL=0 THEN PRINT TAB(20);"No Such Articles in Library"
        PRINT: GOSUB 509  REM PRINT A LINE OF ----'S
        PRINT:PRINT
506     IF PRINTER.FLAG$<>"Y" THEN 40
        PRINT:PRINT:PRINT:PRINT:PRINT:PRINT
507     PRINT"Type any Character followed by CTRL-P"
        INPUT"to turn off the Printer";AA$
        GOTO 35

REM             PRINT A LINE OF ------'S

509     DASHES=64
        IF AA$="Y" THEN DASHES=72
        FOR I=1 TO DASHES
                PRINT "-";
        NEXT I
        PRINT
        RETURN

REM             SEARCH INDEX FILE

510     M=1
        GOSUB 530 REM CLEAR SPOOL MATRIX
511     NUMBER.SEARCH.KEYS=(LEN(KY$)/2)
        FOR J=1 TO EXTENT
                IF INDEX$(J)="0" THEN 519
                IF NUMBER.SEARCH.KEYS=0 THEN 516
```

```
        NEXT I
        IF INT(I/3)<>I/3 THEN PRINT
        PRINT: GOSUB 650: GOTO 35

REM             LIST JOURNALS

620     FOR I=1 TO NM
                PRINT TAB((((I-INT((I-1)/3)*3)-1)*20)+1);\
                  JOURNAL$(I);
                IF INT(I/3)=I/3 THEN PRINT
                IF INT(I/42)=I/42 THEN GOSUB 650
        NEXT I
        IF INT(I/3)<>I/3 THEN PRINT
        PRINT: GOSUB 650: GOTO 35

REM             PAUSE ROUTINE

650     INPUT"Type 'C' to Continue";A$
        RETURN


REM             DECODE A KEY

700     S1$=MID$(KY$,2*II-1,1):S2$=MID$(KY$,2*II,1)
        IF S1$="0" THEN S1=0: GOTO 720
        S1=(ASC(S1$)-64)*26
720     IF S2$="0" THEN S2=0: GOTO 740
        S2=ASC(S2$)-64
740     STRING.NO=S1+S2
        RETURN

REM             SUBSTITUTE ","  FOR "/" IN TITLE AND AUTHOR

750     FOR L=1 TO LEN(TITLE$)
                IF MID$(TITLE$,L,1)<>"/" THEN 760
                TIT.LEFT$=LEFT$(TITLE$,L-1)
                TIT.RIGHT$=RIGHT$(TITLE$,(LEN(TITLE$)-L))
                TITLE$=TIT.LEFT$+","+TIT.RIGHT$
760     NEXT L
        FOR L=1 TO LEN(AUTHOR$)
                IF MID$(AUTHOR$,L,1)<>"/" THEN 770
                AUT.LEFT$=LEFT$(AUTHOR$,L-1)
                AUT.RIGHT$=RIGHT$(AUTHOR$,(LEN(AUTHOR$)-L))
                AUTHOR$=AUT.LEFT$+","+AUT.RIGHT$
770     NEXT L
        RETURN

REM             DISPLAY SIGN-ON MESSAGE

800     PRINT CHR$(CLEAR.SCREEN)
        PRINT "            ----------------------------------------"
        PRINT "            ! RADIOLOGY JOURNAL RETRIEVAL SYSTEM !"
        PRINT "            ----------------------------------------"
        PRINT:PRINT:PRINT
        RETURN

REM             WRITE AN ENTRY TO DATA FILE

900     PRINT #1,J;MG$,DATE$,PAGE$,TITLE$,AUTHOR$,KY$
        PRINT #2,J;INDEX$(J)
        RETURN

REM             DATA SECTION

REM             JOURNAL LIST

        DATA AJR,RADIOLOGY,SIR,JNM,SNM,RCLINICS,0

REM             MONTH LIST

        DATA January,February,March,April,May,June,July
        DATA August,September,October,November,December

REM             KEY WORD LIST

        DATA ANGIOGRAPHY,ARTERIOGRAPHY,ARTHROGRAPHY,ANASTAMOSIS,ANESTHESIA
        DATA ANATOMY,AORTA,ARM,ARTERY,APPENDIX,ANEURYSM,ANKLE,ADRENAL,ALLERGY
```

DATA statement: DATA 0,0.

3. Compile and run this newly modified KYEXPAND Module. When done, the disk files have been correctly modified.

4. Modify the keyword DATA statements in the Main Program Module and the KYEXPAND Module to reflect the presence of the newly added keywords. Take care that the new keywords are added in the right spots, following the appropriate keywords, as specified in the final DATA statements in the KYEXPAND Module.

5. Remove from the KYEXPAND Module the final DATA statements with the keyword pairs; they are no longer needed. The KYEXPAND Module is now fully consistent with the newly modified Main Program Module and is ready for any future additions.

6. Compile the newly modified Main Program Module, which now contains the added keywords; this is now the current version of JOURNAL, which should be used until any further changes are made and the above steps are repeated.

The following example illustrates the proper way in which the Expansion Module should be employed. Let us assume that we wish to add two new keywords: PNEUMONITIS and RETINA.

1. Make sure that the keyword DATA statements at the end of the KYEXPAND Module are identical to those of the Main Program Module. Make changes if necessary.

2. Additional DATA statements are appended to the end of the KYEXPAND Module:

```
DATA PNEUMONIA,PNEUMONITIS
DATA RADIOLOGY,RETINA
DATA 0,0
```

3. Compile and run KYEXPAND; the disk files RADIDATA.LIB and RADIINDX.LIB will be modified appropriately.

4. The DATA statements in both JOURNAL and KYEXPAND are modified to reflect the additions (see Example 7).

5. The final DATA statements

```
DATA ABNORMALITY,AVM,ATROPHY,ARTHRITIS,ABSCESS,ASEPTIC,ABDOMEN
DATA BYPASS,BILIARY,BRAIN,BREAST,BLADDER,BLOOD,BILE DUCT,BONE,BARIUM
DATA BRONCHIECTASIS,BACTERIA,BENIGN,BE,BIOPSY,BRAINSTEM
DATA COLON,COMPUTER,COMPARISON,CATHETERIZATION,CT,COLONOSCOPY,CEREBRUM
DATA CHOLECYSTOGRAPHY,CHEST,CYST,CALCULUS,CALCIUM,COLOSTOMY,CARCINOID
DATA CALCIFICATION,COLITIS,CONTRAST,CERVICAL,COLLAGEN VASCULAR DISEASE
DATA CEREBELLUM,CSF,DOSE,DIAPHRAGM,DYNAMIC,DEVELOPMENT
DATA DIAGNOSIS,DUODENOGRAPHY,DUODENUM,DATA PROCESSING,DYSOSTOSIS,DEATH
DATA DISEASE,DISLOCATION,ESOPHAGUS,EMBOLIZATION,EMISSION,ELBOW
DATA ENDOSCOPY,ENDOCRINE,ECONOMICS,EQUIPMENT,EYE,EAR,ERROR
DATA EMPHYSEMA,EMBOLUS,EMPYEMA,EDEMA,FEMALE
DATA FILM,FALLOPIAN TUBE,FOOT,FIBROSIS,FISTULA,FRACTURE,FAMILIAL
DATA FAILURE,FUNGUS,GENERAL,GI,GU,GALL BLADDER,GRANULOMA,GRAFT,GENITAL
DATA GLUCAGON,GALLIUM,HISTORY,HYPOTONIA,HEAD,HEART,HIP,HAND,HYPERTENSION
DATA HAMARTOMA,HEMATOMA,HEMORRHAGE,HERNIA,HORMONE
DATA INDICATION,IMAGING,INFECTION
DATA INTESTINE,IMMUNITY,IVC,INFARCTION,INFLAMMATION,INSUFFICIENCY,IODINE
DATA ILEOSTOMY
DATA JAW,JOINT,JAUNDICE,KIDNEY,KNEE,LYMPH NODE,LYMPHOMA,LIVER,LUMBAR
DATA LUNG,LONG,LEG,LIPOMA,MALE,MELANOMA
DATA MYELOGRAPHY,MAMMOGRAPHY,MEASUREMENT,MENINGES,MEDIASTINUM,MESENTERY
DATA MYOCARDIUM,MARROW,METABOLIC,METASTASIS,MELANOMA,MALABSORBTION
DATA MAGNIFICATION,MALIGNANT,MANAGEMENT
DATA NOSE,NECROSIS,NASOPHARYNX,NEOPLASM,NEUROLOGY,OTHER,OVARY,OCCLUSION
DATA OBSTRUCTION,ORIBT,PORTOGRAPHY,PHYSICS,PREGNANCY,PHARYNX,PINEAL,POLYP
DATA PELVIS,PARATHYROID,PLEURA,PANCREAS,PENIS,PROSTATE,PEPTIC,PHYSIOLOGY
DATA PITUITARY,PATHOLOGIC,PARALYSIS,PLACENTA,PERFORMANCE
DATA POSTERIOR FOSSA,PEDIATRIC,PNEUMONIA
DATA QUALITY,RADIONUCLIDE SCAN,REMOVAL,RPC,RADIOLOGIST,RADIOLOGY
DATA RADIONUCLIDE,RADIOIMMUNOASSAY,RADIOBIOLOGY,RIB,REFLUX,RHEUMATOID
DATA RADIATION,RECTUM,REVIEW,SACRUM,SKIN,SOFT TISSUE,SACROILIAC,SIGN
DATA SKELETAL,SCAN,SURGERY,SKULL,SVC,SELLA,SPLEEN,STOMACH,SCROTUM,SPINE
DATA SURVEY,SPINAL CORD,SHOULDER,SHUNT,SARCOID,SARCOMA,TECHNETIUM
DATA TRAUMA,THERAPY,TRIAL,TOMOGRAPHY,TRANSMISSION,THERAPUTIC
DATA TELEVISION,TRANSPLANT,THYROID,THYMUS,TESTIS,THORACIC,TUBERCULOSIS
DATA TECHNIQUE,TOXICITY
DATA ULTRASONOGRAPHY,UROGRAPHY,URETER,UTERUS,ULCER
DATA VALVE,VAGINA,VENOGRAPHY,VEIN,VASCULAR,VIRUS,WRIST,XEROGRAPHY,0
```

```
FROM:
    DATA POSTERIOR FOSSA, PEDIATRIC, PNEUMONIA
TO:
    DATA POSTERIOR FOSSA, PEDIATRIC PNEUMONIA, PNEUMONITIS
and FROM:
    DATA QUALTIY, RADIONUCLIDE SCAN, . . . . ,RADIOLOGY
TO:
    DATA QUALITY, RADIONUCLIDE SCAN, . . . . ,RADIOLOGY, RETINA
(NOTE: Strict alphabetical order is not necessary.)
```

Example 7.

(containing the keyword pairs) are removed from the source listing of KYEXPAND.

6. The newly modified JOURNAL (Main Program Module) is compiled and now is the current version.

While this procedure sounds cumbersome, in actuality it takes much less time to do it than describe it! In any event, with normal usage, the KYEXPAND Module will only rarely be used.

Notes on the Program Listings

The listings of the three modules are well commented and will answer most questions that should arise. I might add that one of the benefits of using a compiler such as BASIC-E or CBASIC is that no matter how many comments you include and no matter how long the variable names you use, the size of the compiled code is still the same.

The Main Program Module

The Main Program begins with preliminary initialization of several parameters that are dependent on your particular hardware (CLEAR.SCREEN is the decimal value that, when output to your video display, will clear the screen; KEYBOARD.DATA.PORT is the decimal value of the input port over which your console keyboard communicates with the mainframe—it is used in a direct polling subroutine in the

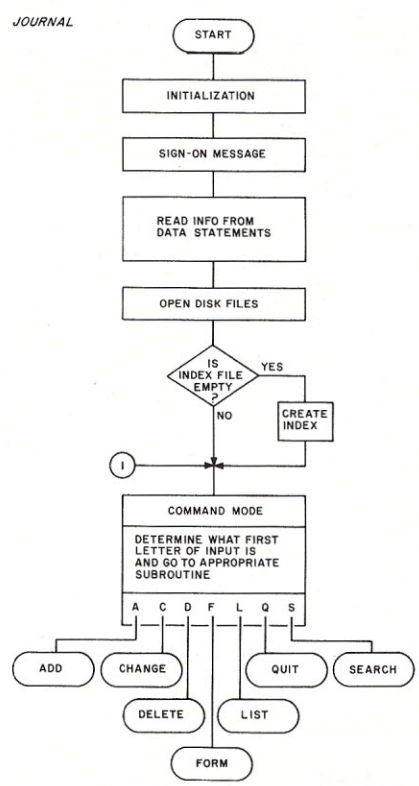

Fig. 1. Main Program flowchart (continued on next two pages).

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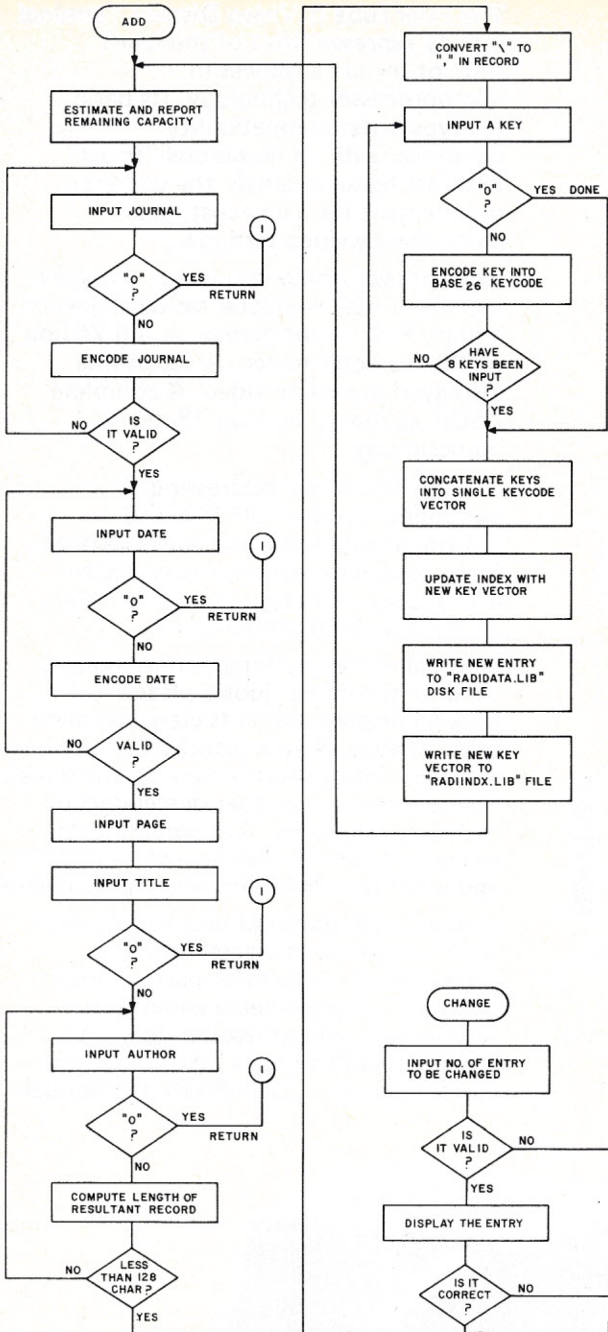
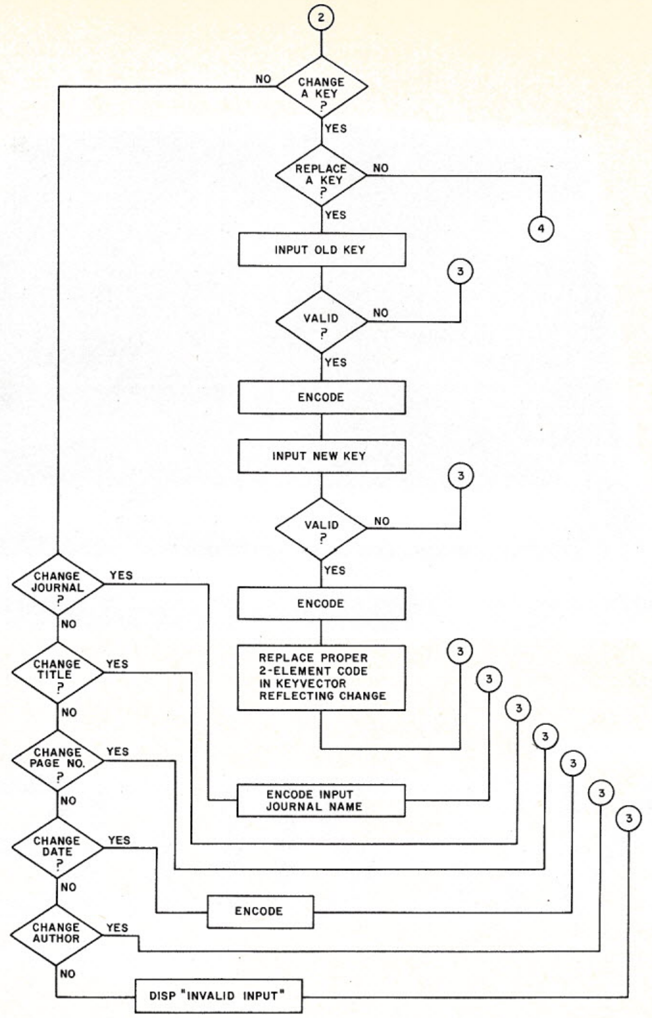
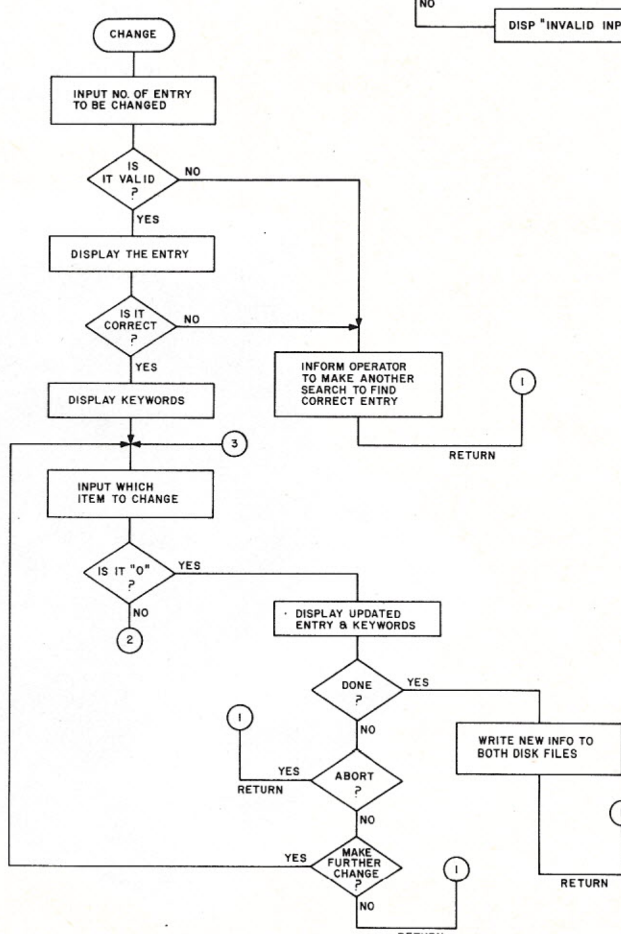






SEARCH subsection). Then, several parameters that define the form of the data base are specified. (MAX.ENTRY is the maximum number of articles handled by the Main Program—see comments below on memory size; MAX.KEYS is the maximum number of individual keywords that any given entry can be associated with; EOF$ is an end-of-file marker needed to close BASIC-E files.)

After dimensioning vector space and signing on, important information from the DATA statements at the end of the program is picked up, valid commands are defined and the diskette files are opened. If an index file (RADIINDX.LIB) is present on the disk, it is read in; if not present, it is created from the data file (RADIDATA.LIB). The program then enters a central command loop from which any of the seven command subroutines may be called. If an invalid command is entered, the computer helps out by reminding you of the valid commands available.

The operation of each separate command subroutine can be discerned by carefully reading the commented source listing. A few particular areas may be a little strange; I shall attempt to explain some of them.

In the ADD subroutine (line numbers in the 100s), after obtaining the PAGE NUMBER, AUTHOR and the TITLE from the user, the program checks to make sure that the resulting record will be less than 128

bytes in length. If it is not, an error message is displayed, admonishing you to abbreviate the length of the AUTHOR and the TITLE, the only two factors over which you have any control concerning length. (Remember, the length of a record includes not only the lengths of the variables, but also the separating quotation marks, commas and a carriage return and line feed.)

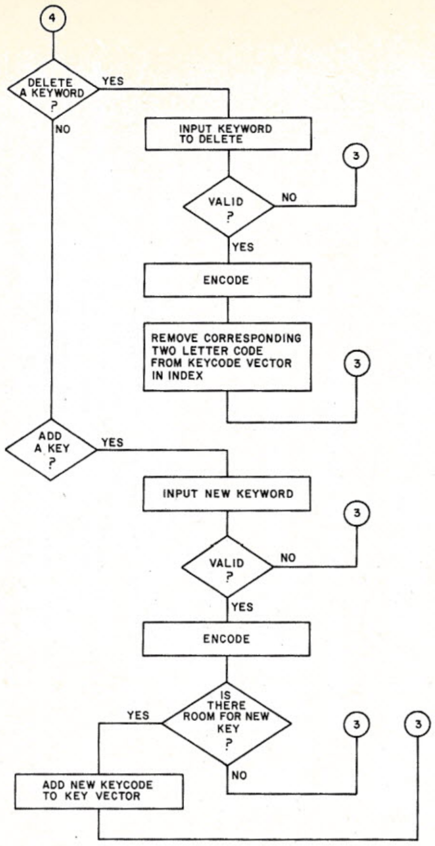
A new entry is added to the library file in the first available slot, whether it be a hole created by a previous DELETE or the end of the existing file. The availability of a slot is flagged by the presence of a simple, one-character 0 in the corresponding core index location. It is in the ADD subroutine that the encoding routines are located (for date, journal name and key).

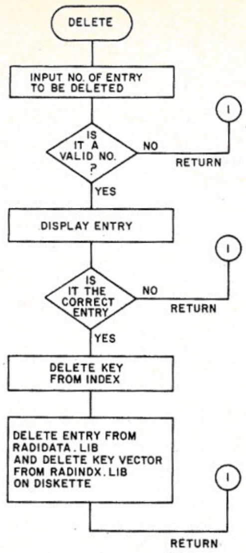
In the ENCODE DATE portion, some tricky stuff is done with the name of the month of publication entered. This is to convert the second and third characters into lowercase ASCII so the appropriate month's name can be matched from the DATA list. (The months are named as Jan, Feb, etc. . . , not JAN, FEB, etc. . . .) The ENCODE KEY section first searches through the valid keys to make a match and then converts the number of the key to a base 26 two-letter code—see previous discussion of the key code system.

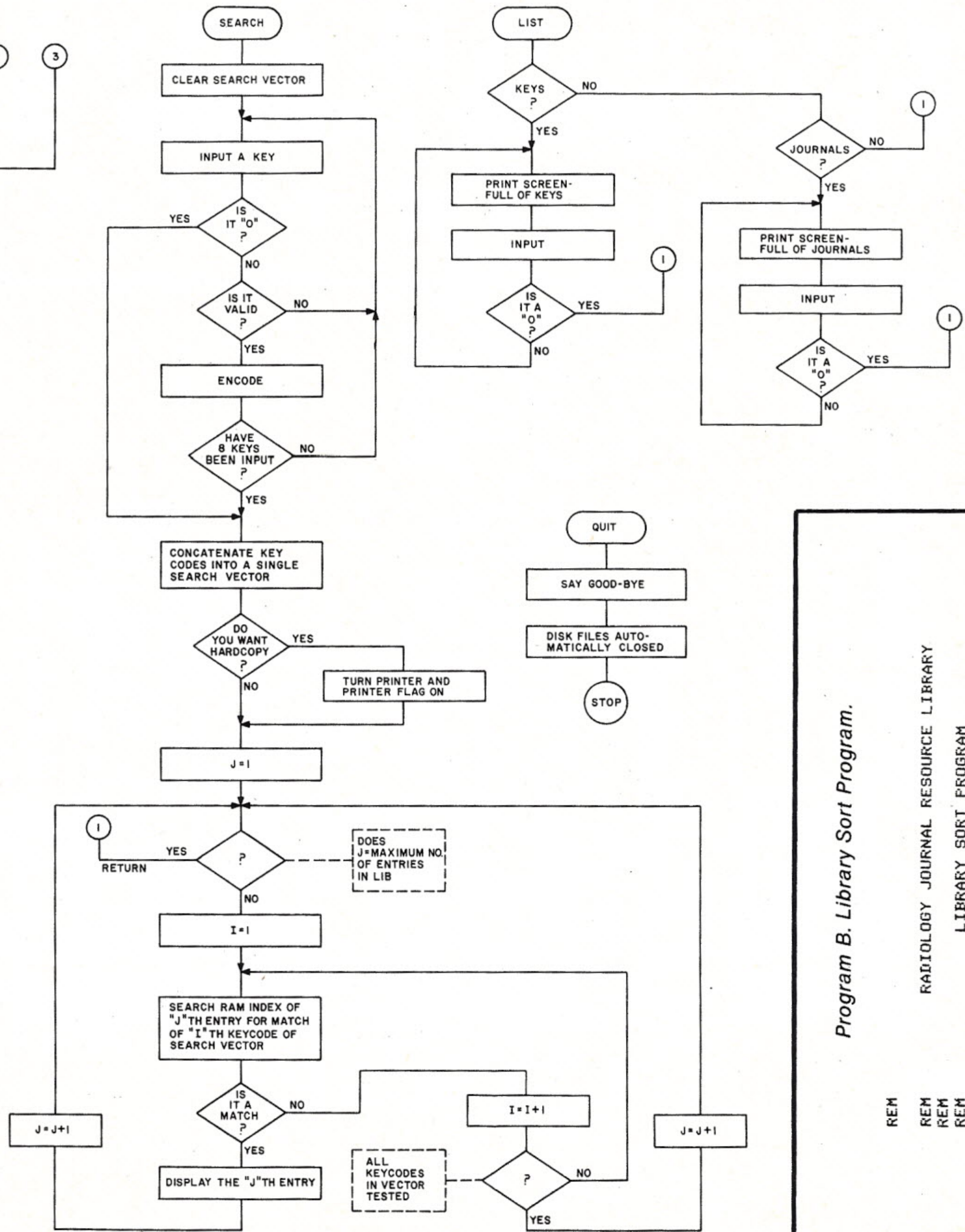
In the SEARCH subroutine section (500s), a sub-subroutine is included (beginning at line 550) which polls the input keyboard for the presence of an ASCII 48 (decimal), a 0. This is to allow interruption of an ongoing display of selected articles and a return to the Command Mode. This involves direct input from the keyboard data port; the port is defined in the first few lines of the program as KEYBOARD.DATA.PORT and may have to be altered if it is not Port 5, as is mine.

In the LIST section (the 600s), formatting for a 64 × 16 character video terminal is done; that is what those strange-looking PRINT TAB and INT(I/42) statements are for. They end up printing three items on each line, 15 lines per screen, before pausing for your viewing pleasure.

The DATA section (no line numbers, at the end) defines the essential character of the program. By merely including different information, the program can be a medical journal, legal journal, computer magazine, ham radio, recipe, etc.,







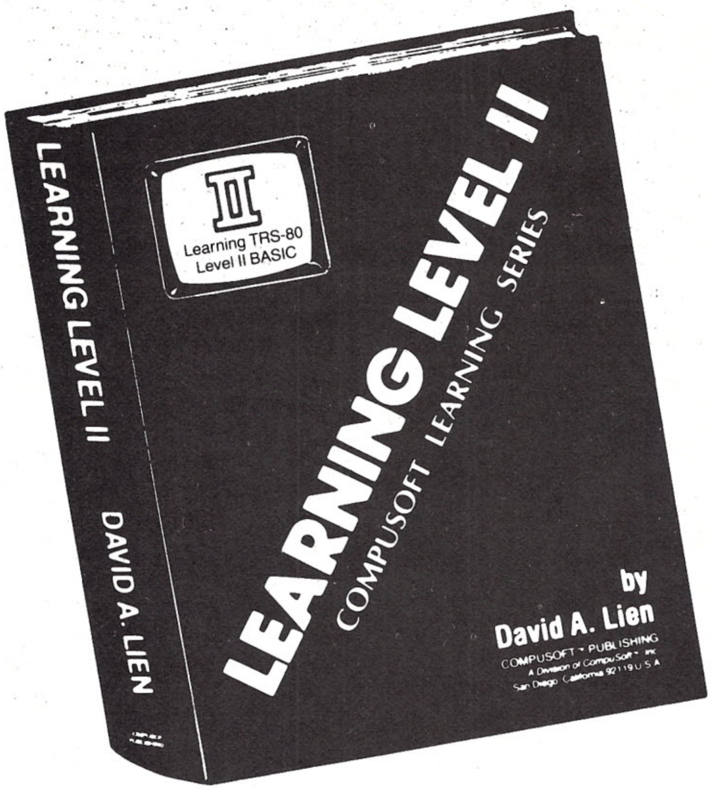
Program B. Library Sort Program.

```
REM
REM     RADIOLOGY JOURNAL RESOURCE LIBRARY
REM
REM            LIBRARY SORT PROGRAM
REM
REM            WRITTEN IN BASIC-E
```

```
REM                              BY
REM               JOSEPH JAY SANGER, M.D.
REM
REM
REM
REM                    JUNE 5, 1978

        CLEAR.SCREEN=12           REM DEFINE SCREEN CLEAR CHAR.
        MAX.ENTRY=650             REM DEFINE MAXIMUM SIZE OF LIBRARY
        MAX.KEYS=8: EOF$=CHR$(26)
        DIM INDEX$(MAX.ENTRY)

        PRINT CHR$(CLEAR.SCREEN)
        PRINT TAB(20);"-------------------------"
        PRINT TAB(20);"! LIBRARY SORT PROGRAM !"
        PRINT TAB(20);"-------------------------"
        PRINT:PRINT:PRINT:PRINT


REM             OPEN FILES

        DATALIB$="RADIDATA.LIB": INDXLIB$="RADIINDX.LIB"
        FILE DATALIB$(128),INDXLIB$(2*MAX.KEYS+4)

REM             READ INDEX FILE

        IF END #2 THEN 975
        FOR I=1 TO MAX.ENTRY
                READ #2,I;INDEX$(I)
        NEXT I
975     EXTENT = I-1
        INDEX$(I)="0"
        IF EXTENT>0 THEN 1000

REM             ARRIVE HERE IF NO INDEX FILE EXISTS

        PRINT TAB(10);"No Index File exists"
        GOTO 1220

REM                     LIBRARY DATA SORT

1000    DIM DUMMY.A$(6),DUMMY.B$(6),SORT(EXTENT)
        DIM SPOOL(EXTENT)

        PRINT CHR$(CLEAR.SCREEN)
        PRINT TAB(22);"Sorting Library"
        PRINT:PRINT:PRINT:PRINT
        PRINT TAB(10);
        PRINT "It is advisable to have a back-up File"
        PRINT TAB(10);
        PRINT "on another diskette before sorting, to avoid"
        PRINT TAB(10);
        PRINT "a catastrophic loss, in the event of an error."
        PRINT:PRINT
        PRINT TAB(12);"Do you wish to continue the sort";
        INPUT A$:A$=LEFT$(A$,1)
        IF A$<>"Y" THEN 1220

        PRINT TAB(16);"Purging Library of null entries"
        PRINT:PRINT:PRINT:PRINT

        COUNTER=0: II=1
1010    IF INDEX$(II)="0" THEN 1020
        II=II+1
        IF II+COUNTER>EXTENT THEN 1050
        GOTO 1010
1020    COUNTER = COUNTER + 1
1030    IF II+COUNTER>EXTENT THEN 1050
1040    IF INDEX$(II+COUNTER)="0" THEN COUNTER = COUNTER + 1:\
          GOTO 1030
        INDEX$(II)=INDEX$(II+COUNTER)
        READ #1,II+COUNTER;DUMMY.A$(1),DUMMY.A$(2),DUMMY.A$(3),\
            DUMMY.A$(4),DUMMY.A$(5),DUMMY.A$(6)
        PRINT #1,II;DUMMY.A$(1),DUMMY.A$(2),DUMMY.A$(3),\
          DUMMY.A$(4),DUMMY.A$(5),DUMMY.A$(6)
        II=II+1: GOTO 1030

1050    EXTENT=EXTENT-COUNTER
        PRINT #1,II;EOF$
```

```
REM             CONSTRUCT INDEX FILE OF DATES
        PRINT CHR$(CLEAR.SCREEN)
        PRINT TAB(11);"Forming and Sorting List of Publication Dates"
        PRINT:PRINT:PRINT:PRINT

        FOR FILE.NO = 1 TO EXTENT
                READ #1,FILE.NO;DUM$,INDEX$(FILE.NO),DUM$,\
                                DUM$,DUM$,DUM$
                SORT(FILE.NO)=FILE.NO
        NEXT FILE.NO

REM             BEGIN SORT

        N=EXTENT
        M=N
1105    M=INT(M/2)
        IF M=0 THEN 1190 REM DONE
        K=N-M: J=1
1108    I=J
1110    L=I+M
        IF INDEX$(I) > INDEX$(L) THEN 1115
1112    J=J+1
        IF J>K THEN GOTO 1105 ELSE GOTO 1108
1115    GOSUB 1175       REM SWAP TWO RECORDS
        I=I-M
        IF I<1 THEN 1112
        GOTO 1110

REM             SWAP TWO RECORDS

1175    DUMMY$=INDEX$(I):INDEX$(I)=INDEX$(L):INDEX$(L)=DUMMY$
        DUMMY=SORT(I):SORT(I)=SORT(L):SORT(L)=DUMMY
        RETURN

REM             SORT SORTED LIST

1190    FOR I=1 TO EXTENT
                SPOOL(I)=I
        NEXT I

        M=N
1191    M=INT(M/2)
        IF M=0 THEN 1200 REM DONE
        K=N-M: J=1
1192    I=J
1193    L=I+M
        IF SORT(I) > SORT(L) THEN 1195
1194    J=J+1
        IF J > K THEN GOTO 1191 ELSE GOTO 1192
1195    GOSUB 1196       REM SWAP TWO RECORDS
        I=I-M
        IF I<1 THEN 1194
        GOTO 1193

REM             SWAP TWO RECORDS

1196    DUMMY=SORT(I): SORT(I)=SORT(L): SORT(L)=DUMMY
        DUMMY=SPOOL(I): SPOOL(I)=SPOOL(L): SPOOL(L)=DUMMY
        RETURN


REM             RE-ORDER DATA FILE IN SORTED ORDER

1200    PRINT CHR$(CLEAR.SCREEN)
        PRINT TAB(17);"Saving Sorted Library File"
        PRINT:PRINT:PRINT:PRINT

        FOR J=1 TO 3
                FOR I=1 TO EXTENT
                IF SPOOL(I)=I THEN 1210
                READ #1,SPOOL(I);DUMMY.A$(1),DUMMY.A$(2),DUMMY.A$(3),\
                        DUMMY.A$(4),DUMMY.A$(5),DUMMY.A$(6)
                READ #1,I;DUMMY.B$(1),DUMMY.B$(2),DUMMY.B$(3), \
                                DUMMY.B$(4),DUMMY.B$(5),DUMMY.B$(6)
                        PRINT #1,SPOOL(I);DUMMY.B$(1),DUMMY.B$(2),DUMMY.B$(3), \
                              DUMMY.B$(4),DUMMY.B$(5),DUMMY.B$(6)
                        PRINT #1,I;DUMMY.A$(1),DUMMY.A$(2),DUMMY.A$(3),\
                        DUMMY.A$(4),DUMMY.A$(5),DUMMY.A$(6)
                        DUMMY=SPOOL(I): SPOOL(I)=SPOOL(SPOOL(I))
```

It's Here At Last . . .



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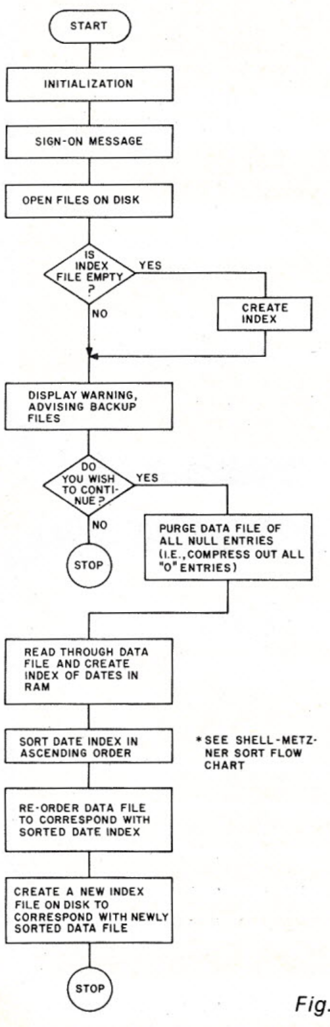
```
1210        NEXT I
                    SPOOL(DUMMY)=DUMMY
      NEXT J

      PRINT CHR$(CLEAR.SCREEN)
      PRINT TAB(12);"Library File is now in chronological order"
      PRINT:PRINT:PRINT:PRINT

REM         FORM AND SAVE NEW INDEX FILE

      PRINT TAB(21);"Forming a new Index"
      PRINT:PRINT:PRINT:PRINT

      IF END #1 THEN 1215
      FOR I=1 TO MAX.ENTRY-1
          READ #1,I;DUM$,DUM$,DUM$,DUM$,DUM$,INDEX$(I)

1215  NEXT I
      EXTENT = I-1

REM         SAVE INDEX FILE

      PRINT TAB(18);"Saving updated Index File"
      PRINT:PRINT:PRINT:PRINT

      FOR I=1 TO EXTENT
          PRINT #2,I;INDEX$(I)
      NEXT I
      PRINT #2,I;EOF$
      STOP

REM         SORT IS ABORTED

1220  PRINT TAB(12);"The Sort has been Aborted"
      PRINT:PRINT:PRINT:PRINT
      STOP

A>
```



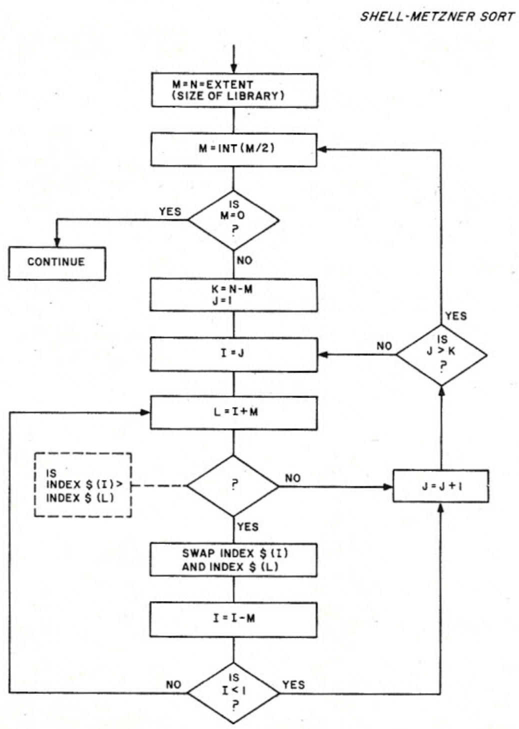


Fig. 2. Sort Program flowchart.

organization device. The keyword list can be appropriately tailored to the desired situation—for my Personal Computer Article Library, such terms as CONSTRUCTION, LANGUAGE, ASSEMBLER, STARTREK, ARTIFICIAL INTELLIGENCE, etc., are used.

It is recommended that the keys be listed in the DATA statements in alphabetical order, at least according to the first letter. This makes the LIST command much easier to deal with; if the valid keys are LISTed in a random order, it is very difficult to make sense of them at all (Remember: Once the Key Word List is defined and articles are entered into the library, changing the order of the keys will invalidate the correspondence between the codes in the file entries and the intended keys. No problem exists if new keywords are added to the END of the existing list, but adding one in the middle will skew the entire remaining list.)

If the nature of the library program needs to changed more drastically, such information as PAGE number, AUTHOR and TITLE may no longer be appropriate. In that case, a few computer-generated prompts would need changing—perhaps a subroutine or two—but the basic program structure should be quite usable.

One word about memory size—I am running the system in 40K of core and can maintain a file of approximately 400 entries. Additional RAM will increase the maximum size of the library at the rate of approximately 600 entries per 8K. If you do expand the size of the library, make sure you respecify the MAX.ENTRY parameter in the initialization section of the three modules.

If your system has much less than 40K, you may find it necessary to further fragment the program into modules, in a similar manner to that done with the Sort and Key Expansion routines. For example, you might consider separating Data Entry and Editing routines from the Search functions.

On a single density CP/M system, up to approximately 1500 entries may be stored on a single diskette; this would require about 62K of RAM. Going to a double-density system does not buy you any more capability, because the limiting factor is the amount of addressable core (at least with the program in the present form).

The Sort Module

The Sort Module performs some initialization similar to that in the Main Program Module and then signs on. The

Program C. Key Expansion Module.

```
REM
REM          RADIOLOGY JOURNAL RESOURCE LIBRARY
REM
REM               KEY EXPANSION MODULE
REM
REM                 WRITTEN IN BASIC-E
REM                        BY
REM              JOSEPH JAY SANGER, M.D.
REM
REM
REM                   JUNE 7, 1978
REM
REM

      CLEAR.SCREEN=12         REM DEFINE SCREEN CLEAR CHARACTER
      MAX.KEYS=8
      MAX.ENTRY=650

      DIM CODE$(MAX.ENTRY),KEY$(676)

REM         OPEN FILES

      DATALIB$="RADIDATA.LIB":INDXLIB$="RADIINDX.LIB"
```

index file is then read in from the disk, and a warning message about backup files is printed.

A purge routine (lines 1010-1050) is then performed, which steps through the index file looking for 0s in the index, which signify vacancies from previous unreplaced DELETE commands. These are then eliminated by "compressing" the subsequent entries into the holes, both in the core-resident index and on the diskette Data file.

Next, another core-resident index file is created, not containing the key codes, but containing the encoded dates of publication. This index is sorted in lines 1105-1210 by a Shell-Metzner sort; the diskette Data file is adjusted to correspond to the sorted order, and the net result is chronologically ordered RADIDATA.LIB and RADIINDX.LIB files. (Again, for details on the Sorting algorithm, see *Creative Computing*, Vol. 2, No. 6, Pg. 75.)

The Key Expansion Module

After initialization, the index file is read into core (see lines 50-55), and the old keyword list is picked up from the DATA statements (lines 60-70). Then, using the new keyword pairs from the terminal DATA statements, an "increment matrix" is constructed. The matrix contains, for each keyword in the old list, an "offset" indicating the number of new keys that have been added before the given keyword.

This offset is subsequently added to the base 26 key code for each keyword and results in a new, properly adjusted code for each word (lines 300-320). Finally, the new key codes are inserted into the RADIDATA.LIB file in the proper positions, and a new RADIINDX.LIB file is created and saved. Lines in the 500s form a conversion routine between base 26 and base 10.

Summing It All Up

JOURNAL and its utility routines, RADSORT and KYEXPAND, form an example of a comprehensive, yet easily implementable, data organization system that has wide applicability.

I am eager to hear from any people implementing a version of JOURNAL for themselves. I can be reached at the address that is provided in the byline at the beginning of this article. ■

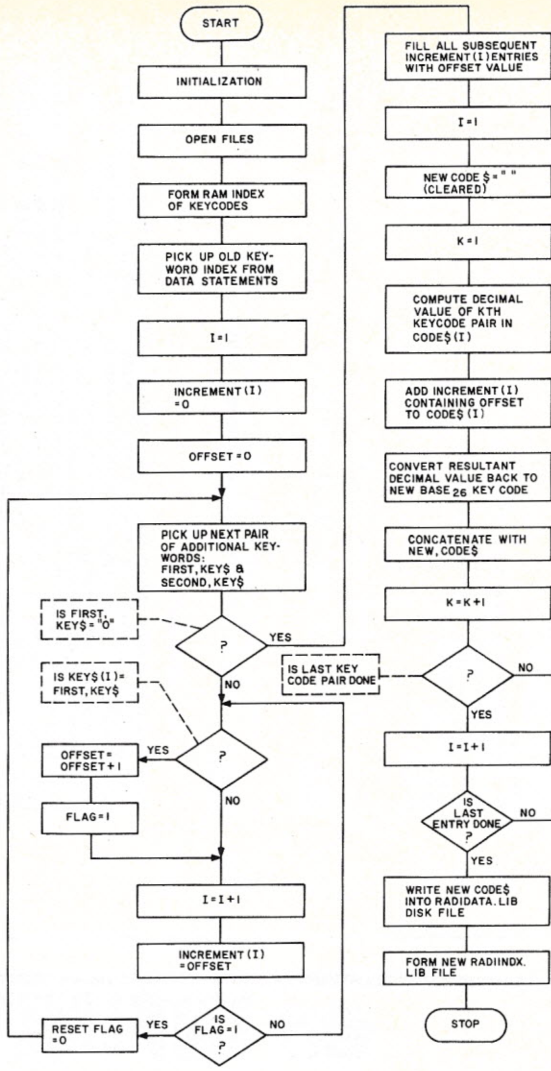
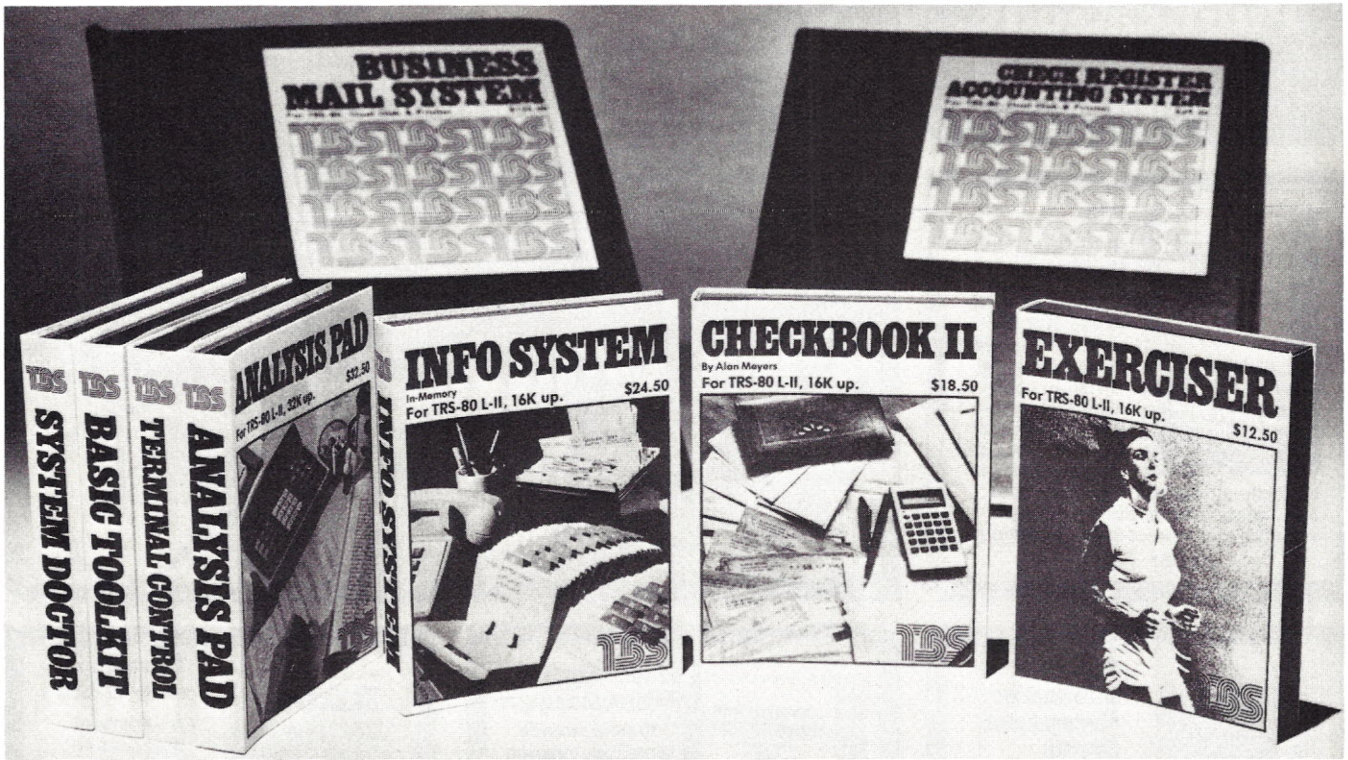


Fig. 3. Key Expansion flowchart.

```
        FILE DATALIB$(128),INDXLIB$(2*MAX.KEYS+4)

REM           FORM KEY CODE MATRIX IN CORE

        PRINT "FORMING KEY CODE MATRIX IN CORE":PRINT
50      IF END #2 THEN 55
        FOR I=1 TO MAX.ENTRY
                READ #2,I;CODE$(I)
        NEXT I
55      EXTENT=I-1

REM           READ OLD KEY WORD LIST

        PRINT "READING KEY WORDS FROM DATA STATEMENTS":PRINT
60      FOR I=1 TO 676
                READ KEY$(I)
                IF KEY$(I)="0" THEN 70
        NEXT I
70      NUMBER.OF.KEYS=I-1

        DIM INCREMENT(NUMBER.OF.KEYS+1)

REM           FORM INCREMENT MATRIX

        PRINT "FORMING INCREMENT MATRIX ON BASIS OF ADDED KEYS":PRINT
100     I=1: INCREMENT(1)=0
        OFFSET=0
105     READ FIRST.KEY$,SECOND.KEY$
        IF FIRST.KEY$="0" THEN 150
110     IF KEY$(I)=FIRST.KEY$ THEN OFFSET=OFFSET+1: FLAG=1
        I=I+1
        INCREMENT(I)=OFFSET
        IF FLAG=1 THEN FLAG=0: GOTO 105
        GOTO 110
150     FOR J=I+1 TO NUMBER.OF.KEYS
                INCREMENT(J)=OFFSET
        NEXT J

REM           ADJUST KEY CODES IN CODE MATRIX

        PRINT "ADJUSTING KEY CODES IN CORE MATRIX":PRINT
300     FOR I=1 TO EXTENT
                NEW.CODE$=""
                FOR K=1 TO LEN(CODE$(I))/2
                        X$=MID$(CODE$(I),2*K-1,2)
                        REM     CONVERT CODE$ TO NUMERIC POINTER
                        XL$=LEFT$(X$,1): XR$=RIGHT$(X$,1)
                        IF XL$="0" THEN XL=0: GOTO 310
                        XL=(ASC(XL$)-64)*26
310                     IF XR$="0" THEN XR=0: GOTO 320
                        XR=ASC(XR$)-64
320                     POINTER=XL+XR
                        POINTER=POINTER+INCREMENT(POINTER)
                        GOSUB 500       REM     COMPUTER NEW CODE$
                        NEW.CODE$=NEW.CODE$+X$
                NEXT K
                CODE$(I)=NEW.CODE$
        NEXT I

REM           WRITE NEW CODES TO DISK

        PRINT "WRITING NEW CODES OUT TO RADIDATA.LIB FILE":PRINT
        FOR I=1 TO EXTENT
                GOSUB 1100      REM     READ AN ENTRY FROM DISK
                GOSUB 1200      REM     WRITE UPDATED ENTRY TO DISK
        NEXT I

REM           FORM A NEW INDEX FILE ("RADIINDX.LIB")

        PRINT "FORMING AND SAVING UPDATED INDEX FILE": PRINT

        FOR I=1 TO EXTENT
                PRINT #2,I;CODE$(I)
        NEXT I

        PRINT "KEYWORD EXPANSION IS COMPLETED":PRINT
```

```
        STOP
REM          CONVERT POINTER BACK TO A CODE$

500     COUNTER=0
510     IF POINTER<26 THEN 520
        POINTER=POINTER-26
        COUNTER=COUNTER+1
        GOTO 510
520     IF COUNTER=0 THEN X1$="0": GOTO 530
        X1$=CHR$(64+COUNTER)
530     IF POINTER=0 THEN X2$="0": GOTO 540
        X2$=CHR$(64+POINTER)
540     X$=X1$+X2$
        RETURN

REM          READ AN ENTRY FROM DISK FILE

1100    READ #1,I;MG$,DATE$,PAGE$,TITLE$,AUTHOR$,KY$
        RETURN

REM          PRINT AN UPDATED ENTRY TO DISK FILE
1200    PRINT #1,I;MG$,DATE$,PAGE$,TITLE$,AUTHOR$,CODE$(I)
        RETURN

REM          OLD KEY WORD LIST

        DATA ANGIOGRAPHY,ARTERIOGRAPHY,ARTHROGRAPHY,ANASTAMOSIS,ANESTHESIA
        DATA ANATOMY,AORTA,ARM,ARTERY,APPENDIX,ANEURYSM,ANKLE,ADRENAL,ALLERGY
        DATA ABNORMALITY,AVM,ATROPHY,ARTHRITIS,ABSCESS,ASEPTIC,ABDOMEN
        DATA BYPASS,BILIARY,BRAIN,BREAST,BLADDER,BLOOD,BILE DUCT,BONE,BARIUM
        DATA BRONCHIECTASIS,BACTERIA,BENIGN,BE,BIOPSY,BRAINSTEM
        DATA COLON,COMPUTER,COMPARISON,CATHETERIZATION,CT,COLONOSCOPY,CEREBRUM
        DATA CHOLECYSTOGRAPHY,CHEST,CYST,CALCULUS,CALCIUM,COLOSTOMY,CARCINOID
        DATA CALCIFICATION,COLITIS,CONTRAST,CERVICAL,COLLAGEN VASCULAR DISEASE
        DATA CEREBELLUM,CSF,DOSE,DIAPHRAGM,DYNAMIC,DEVELOPMENT
        DATA DIAGNOSIS,DUODENOGRAPHY,DUODENUM,DATA PROCESSING,DYSOSTOSIS,DEATH
        DATA DISEASE,DISLOCATION,ESOPHAGUS,EMBOLIZATION,EMISSION,ELBOW
        DATA ENDOSCOPY,ENDOCRINE,ECONOMICS,EQUIPMENT,EYE,EAR,ERROR
        DATA EMPHYSEMA,EMBOLUS,EMPYEMA,EDEMA,FEMALE
        DATA FILM,FALLOPIAN TUBE,FOOT,FIBROSIS,FISTULA,FRACTURE,FAMILIAL
        DATA FAILURE,FUNGUS,GENERAL,GI,GU,GALL BLADDER,GRANULOMA,GRAFT,GENITAL
        DATA GLUCAGON,GALLIUM,HISTORY,HYPOTONIA,HEAD,HEART,HIP,HAND,HYPERTENSION
        DATA HAMARTOMA,HEMATOMA,HEMORRHAGE,HERNIA,HORMONE
        DATA INDICATION,IMAGING,INFECTION
        DATA INTESTINE,IMMUNITY,IVC,INFARCTION,INFLAMMATION,INSUFFICIENCY,IODINE
        DATA ILEOSTOMY
        DATA JAW,JOINT,JAUNDICE,KIDNEY,KNEE,LYMPH NODE,LYMPHOMA,LIVER,LUMBAR
        DATA LUNG,LONG,LEG,LIPOMA,MALE,MELANOMA
        DATA MYELOGRAPHY,MAMMOGRAPHY,MEASUREMENT,MENINGES,MEDIASTINUM,MESENTERY
        DATA MYOCARDIUM,MARROW,METABOLIC,METASTASIS,MELANOMA,MALABSORBTION
        DATA MAGNIFICATION,MALIGNANT,MANAGEMENT
        DATA NOSE,NECROSIS,NASOPHARYNX,NEOPLASM,NEUROLOGY,OTHER,OVARY,OCCLUSION
        DATA OBSTRUCTION,ORIBT,PORTOGRAPHY,PHYSICS,PREGNANCY,PHARYNX,PINEAL,POLYP
        DATA PELVIS,PARATHYROID,PLEURA,PANCREAS,PENIS,PROSTATE,PEPTIC,PHYSIOLOGY
        DATA PITUITARY,PATHOLOGIC,PARALYSIS,PLACENTA,PERFORMANCE
        DATA POSTERIOR FOSSA,PEDIATRIC,PNEUMONIA
        DATA QUALITY,RADIONUCLIDE SCAN,REMOVAL,RPC,RADIOLOGIST,RADIOLOGY
        DATA RADIONUCLIDE,RADIOIMMUNOASSAY,RADIOBIOLOGY,RIB,REFLUX,RHEUMATOID
        DATA RADIATION,RECTUM,REVIEW,SACRUM,SKIN,SOFT TISSUE,SACROILIAC,SIGN
        DATA SKELETAL,SCAN,SURGERY,SKULL,SVC,SELLA,SPLEEN,STOMACH,SCROTUM,SPINE
        DATA SURVEY,SPINAL CORD,SHOULDER,SHUNT,SARCOID,SARCOMA,TECHNETIUM
        DATA TRAUMA,THERAPY,TRIAL,TOMOGRAPHY,TRANSMISSION,THERAPUTIC
        DATA TELEVISION,TRANSPLANT,THYROID,THYMUS,TESTIS,THORACIC,TUBERCULOSIS
        DATA TECHNIQUE,TOXICITY
        DATA ULTRASONOGRAPHY,UROGRAPHY,URETER,UTERUS,ULCER
        DATA VALVE,VAGINA,VENOGRAPHY,VEIN,VASCULAR,VIRUS,WRIST,XEROGRAPHY,0

REM          ADDITIONAL KEY WORD PAIRS

        DATA PNEUMONIA,PNEUMONITIS
        DATA RADIOLOGY,RETINA
        DATA 0,0
```

THE BEST.



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Text Editing for the TRS-80

Use the editing features built into Level II BASIC for text editing.

Roland Abe
53-836 G Kam Highway
Hauula HI 96717

Text editing, a useful application of computers, is usually accomplished by using elaborate editing programs that take up memory space that could otherwise store text. Radio Shack Level II BASIC contains an excellent program editor that can also serve as a text editor through the use of simple programming tricks.

The Problem and Solution

The Level II editing command does not distinguish between text and programs. Text can be given line numbers and edited as easily as a BASIC program. The problem with doing this is that the text will always be printed with distracting line numbers starting each line.

A way around this problem is to store the text as an alphanumeric string (see Listing 1). Although this program is short, more than 4K of memory is necessary to run it due to the string space it requires.

Using the Program

To use the Text Writer program, type it into your TRS-80 and save it on cassette. When you want to use it, CLOAD it then type AUTO 10,5. This automatically generates line numbers in increments of five starting with line 10.

Next, type in the text a line at a time, limiting it to 60 characters a line. The last text line is line 70, for a total of 13 lines of text.

After typing in the text, edit it using the EDIT command as you would for a program. If future editing is desired, save the raw text using the CSAVE command as you would for a program.

To save the text alone, type LIST 10-70. Cue the tape, then put the recorder in the record mode. Make sure that the remote plug is in place.

After this is done, type RUN 200. The line numbers on the screen will disappear, as will the two bottom screen lines. Next, the recorder will start as the text is saved on tape.

Use Listing 2 to read back the recorded text and display it on the screen. For hard-copy output, replace the PRINT statements of lines 20 to 23 with LPRINT commands.

How the Program Works

The Text Writer program starts by erasing all characters not part of the text from the screen. This is done to give the user a view of the text as it will be saved on tape.

Next, memory space is reserved for text storage. Since string variables are limited to 255 characters in length, four strings (P$, Q$, R$, S$) are necessary to store all the text displayed on the screen. This is done in lines 230 to 340 using the PEEK function to transfer the text from the screen to the four string arrays. Lines 350 to 410 save the edited text on tape.

The Text Reader program is much simpler than the Text Writer program. First, memory is reserved for string space. Next, the four string variables are read in from tape. Finally, the recovered text is displayed on the screen.

Conclusion

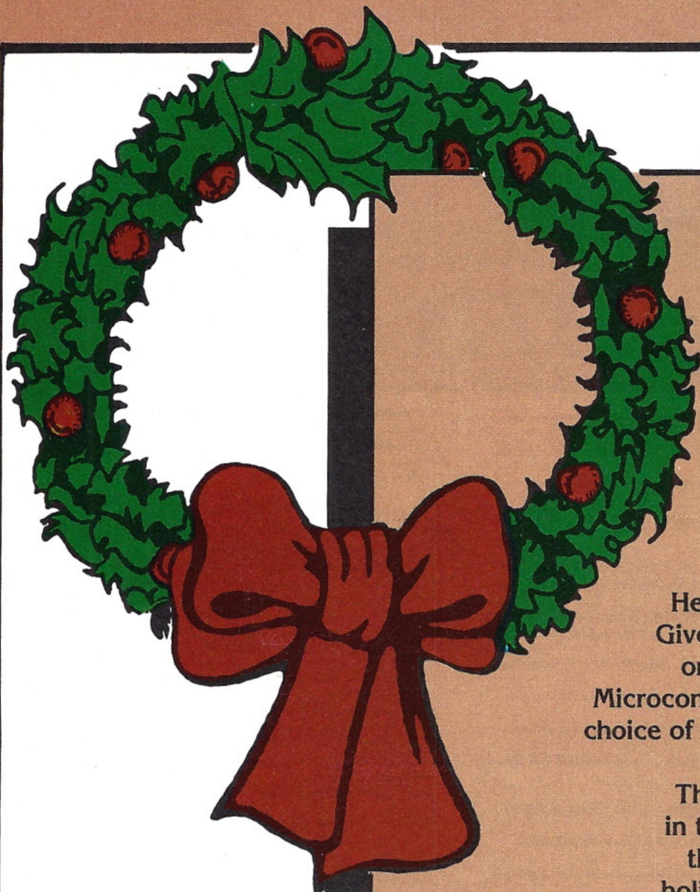
I have described a method for using the editing features built into Level II BASIC for text editing. A practical program using this scheme would probably keep track of named text files on tape and have the ability to store more than 13 lines of text at a time, just to name two of the possible extensions. Since the needs of each user will vary with his or her specific application, users of this scheme should tailor it to their own needs. ■

```
200 FOR M=15360 TO 16128 STEP 64
210 POKE(M),32:POKE(M+1),32:NEXT
215 FOR M=16192 TO 16383:POKE(M),32:NEXT
220 DIM P$(254),Q$(254),R$(254),S$(61)
225 CLEAR 1024
230 FOR I=15362 TO 15615
240 P$=P$+CHR$(PEEK(I))
250 NEXT
260 FOR I=15618 TO 15871
270 Q$=Q$+CHR$(PEEK(I))
280 NEXT
290 FOR I=15874 TO 16127
300 R$=R$+CHR$(PEEK(I))
310 NEXT
320 FOR I=16130 TO 16191
330 S$=S$+CHR$(PEEK(I))
340 NEXT
350 PRINT#-1,P$
370 PRINT#-1,Q$
390 PRINT#-1,R$
410 PRINT#-1,S$
```

Listing 1. Text Writer program.

```
5 CLEAR 1024:DIM P$(254),Q$(254),R$(254),S$(61)
10 INPUT#-1,P$
11 INPUT#-1,Q$
12 INPUT#-1,R$
13 INPUT#-1,S$
15 CLS
20 PRINTP$
21 PRINTQ$
22 PRINTR$
23 PRINTS$
```

Listing 2. Text Reader program.



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□Make Your 680b Smarter . . . *a cheap memory expander*
□Stop Bugs Now!
□Clocked Logic . . . *Part 1: The D Type and JK Flip-flops*
□The Gory Details of Cassette Storage
□The Fun of Learning BASIC
□Super-Tube . . . *jazzing up the Digital Group TVT*

April 1977

□Interrupts Exposed . . . *using microprocessor interrupt capability effectively*
□Clocked Logic . . . *Part 2: Some Basic Applications*
□Build an Eight Channel Multiplexer for Your Scope
□Sorting Routines
□Number Rounding Program
□Meet the Tarbell/KC Interface
□Super-Tester . . . *a digital design aid*
□The Hobbyist's Operating System . . . *Part 3: Command Language Processing*
□The Slow-Stepping Debugger
□BASIC—The Easy Way
□Now You Can Use Software Timing Loops
□KIM-1 Memory Expansion
□Heavy Duty Power Supply
□Digital Audio
□HI-LO
□Interfacing the Analog World
□Everything about Semiconductor Memory
□Three-State Logic . . . *explanation of a key microprocessor element*
□Automatic Memory Dumper . . . *utility dump program for 6800 users*
□Hangmath! . . . *a new puzzle/game*
□Now—BASIC for the 8008—Even!
□Microprogramming . . . *an insight into microprocessor design*
□Computerized Babysitter

May 1977

□Clocked Logic . . . *Part 3: Data Converters and Special Functions*
□Cure Those End-of-Month Blues . . . *with a sales analysis program*
□Make Your Investment Count . . . *the inside view of a custom MP-68*
□Speed Up Your 6800
□Who's Afraid of RS-232 . . . *data communications explained!*
□Is it High?—or Low? . . . *understanding logic design conventions*
□Know Thyself! . . . *confessions of a kit-builder*
□Protyping Systems Exposed! . . . *a revealing look at the Intercept Jr.*
□Interrupts Exposed . . . *Part 2: Implementing an Interrupt-driven System*
□Digital Audio . . . *Part 2: Generating that Weird Music*
□Now It's Imsai BASIC!
□Bridging the Gap . . . *tips on turning an application into a program*
□Adding "Plop" to Your System . . . *a noisemaker for computer games*
□Lunar Lander
□Silence Noisy Teletype Motors . . . *Part 1: Getting the Ball Rolling*
□A Home Computer Pioneer . . . *profile of Don Tarbell*

June 1977

□Build Your Own Interface
□Computer Club Promotional Techniques
□Artillery Practice
□Put a Micro in Your School
□Torpedoes Away!
□Build a Pulse Generator
□A TVT For Your KIM
□The BYTEDESTROYER . . . *review of an EPROM eraser*
□BASIC Timing Comparisons
□Solving Keyboard Interface Problems
□A Clean Cassette
□Try a Design Console . . . *for practical hardware prototyping*
□Try Solar Energy
□Simplified Billing System . . . *in BASIC for the small business*
□Kilobaud Klassroom . . . *No. 2: Gates and Flip-flops Explained*
□Computerized Typesetting . . . *an introduction to word processing*
□Introducing! The World's Cheapest Computer . . . *a $60 SC/MP*
□My Friend is a Computer Junkie

July 1977

□Inside the Sphere Microcontroller
□The Great TV to CRT Monitor Conversion
□Computer Turns Director . . . *an interview with filmmaker John Whitney*
□The Random Number Game
□Cassette Interface First Aid . . . *use your processor to set timing*
□Understand Your Computer's Language
□Kilobaud Klassroom . . . *No. 3: JK Flip-Flops and Clock Logic*
□Digital Audio . . . *Part 3: Signal Expansion and Compression*
□It Was Great! . . . *reviewing The First West Coast Computer Faire*
□Pass the Buck . . . *computer decision-maker program*
□Inside the Amazing ASR 33 . . . *checking out the most popular terminal*
□Try Computer Composition

August 1977

□Cassette I/O Format
□Expand Your SWTP 6800 . . . *with a new 8K board*
□Trigger Your Oscilloscope
□Sobriety Tester Program
□Random Integer Program
□Test ICs With Your Micro
□Heavy Duty Altair Power Supply
□Is the KIM-1 For Every-1?
□Electronic Design by Computer
□Understand Your Computer's Language . . . *Part 2: Instruction Sets*
□Enter the Audible Computer!
□Time Bomb Game
□Try a Do-All Program!
□Sooo, You Want to be an Author!
□SWTP 4K BASIC Notes . . . *implementing it on the 680b*
□Hexdec . . . *hexadecimal to decimal conversion*
□Start a One-Man Computer Club
□Troubleshoot Your Software . . . *a trace program for the 6502*
□Cure that Hot Power Supply

September 1977

□Build Your Own ASCII Keyboard . . . *with serial and parallel output*
□The Ultimate Personal Computer
□Talk Your Computer's Language!
□A PET For Every Home . . . *a look at the Commodore PET 2001*
□Kilobaud Klassroom . . . *No. 4: PC boards and power supplies*
□Seals Electronics
□Try an 8080 Simulator
□Build a $20 EPROM Programmer . . . *for the 5402 4K chip*
□Faster MIKBUG Load Technique . . . *uses binary format*
□Decoding Device Control Codes . . . *uses a UART, naturally*
□Tarbell Asynchronous Format
□Baseball in BASIC
□Using an Invisible PROM . . . *how to relocate monitor programs*
□Klingon Capture Game
□Starting a Business?

October 1977

□BASIC Timing Comparisons
□Learn and Earn . . . *BASIC and business programming*
□Bargain Time!
□Hello! Today's Program Is . . . *understanding computer speech recognition*
□Beware the Altair Bus
□Put Your Imsai on the Rack!
□3D Computer Graphics
□Memory Troubleshooting Techniques
□Understand Your Interrupts! . . . *real time clock applications*
□Kilobaud Klassroom . . . *No. 5: hardware logical functions*
□Digital Group MAXI-Basic
□Utilize ASCII Control Codes!
□Dedicated Controllers
□Try WORDMATH!
□Time for Timesharing?
□Build a Universal I/O Board . . . *for your Altair*

November 1977

□Everything about Assemblers! . . . *sure beats hand-coding*
□Your Image Counts!
□Lifetime Program
□Consider a MITE Printer . . . *alternative to the ASR-33*
□Tired of Substituting Chips?
□Stretch Those Characters . . . *mods for the SWTP PR-40*
□Magnetic Bubble Memory
□Reliable Conversion Techniques
□Salesmanship, Hardware and Coffee
□Hyper about Slow Load Times? . . . *KIM Hypertape is an alternative*
□Interested in Commercial Programming?
□Kilobaud Klassroom . . . *No. 6: voltage, current and power supplies*
□Expand Your KIM! . . . *with Altair bus devices*
□Enhance Your Memory . . . *with home information retrieval*
□Build the $35 Modem . . . *uses the MC14412 and a UART*
□Another Look at Benchmark Program
□Son of Submarine Game
□Payroll Program . . . *for small businessmen*
□SC/MP Goes Baudot . . . *add an inexpensive TTY*

December 1977

□TVT Hardware Design . . . *Part 1: instruction decoder and scan*
□Expand Your KIM! . . . *Part 2: getting to the nuts and bolts*
□Payroll Program (Continued) . . . *cassette techniques*
□The Business Market
□ALL CAPS
□The "Learning Machine" . . . *math tutor program*
□Kilobaud Klassroom . . . *No. 7: transistors, diodes and op amps*
□Compleat Guide to Logic Diagrams
□Tiny BASIC
□The Twelve Days of Christmas
□Paper Tape: It's Here to Stay . . . *a look at the OP-80A*
□Tempus Fugit
□Who Needs a Broker?
□Here's HUEY! . . . *super calculator for the 6502*
□Crash Landing! . . . *a real-time Lunar Lander game*
□File Structures Simplified

***issues not available.**

kilobaud microcomputing

articles you may have missed during '78 & '79

January 1978

- Business Applications
- Growing with KIM . . . *expansion PC board*
- Has Godbout Done It Again? . . . *Econoram II: $150 assembled*
- The TRS-80: how does it stack up?
- A Tale of Four BASICs
- Hardware Program Relocation
- TVT Hardware Design
- Understanding Loaders
- Kilobaud Klassroom . . . *No. 8: pulses—and more pulses*
- Help for Beginning Programmers
- Your Imsai and You
- Rocket Pilot . . . *an interactive game for the Apple-II*
- Micro Maestro
- Software Keyboard Interface
- Morrow's I/O Cassette Board
- It's Your Hobby!

February 1978*

March 1978

- Build the "Simple Computer" . . . *a home-brew 8080*
- Hardware Program Relocation, Part 2
- State Capitals
- Customized MIKBUG
- TV Typewriter Update
- Foolproof Cassette Operation
- Number-Crunching Time
- Super Terminal! . . . *interfacing the Burroughs 9350-2*
- Consumer Computer, Inc.
- Programmed Instruction Made Easy: Tiny PILOT, Part 1
- Protect Your Memory Against Power Failure
- Backup Techniques . . . *how fail-safe is your system?*
- Small Business Software, Part 2
- Expand Your KIM! . . . *Part 4: a TTY substitute*
- Faster Erase Times . . . *build a quicker EPROM eraser*
- I/O Programming for the Altair Disks
- The Axiom EX-800
- Tiger Trouble! . . . *TI programmable-calculator safari*
- Temperature Sensing
- A Different Approach to HI-LO

April 1978*

May 1978*

June 1978*

July 1978

- Two Hobbies: Model Railroading and Computing
- Revolving Charge Account Calculations
- A Tour of the Faire, Part 2
- Taming the I/O Selectric . . . *Part 2: software*
- Heath's Experimenter's Breadboard
- Draw Dazzling Color Graphics . . . *routines for Cromemco's Dazzler*
- Atwood Memory for Your KIM
- MIKBUG with Muscle!
- Little Bits . . . *strings, statements, routines*
- Cook's Memory Test . . . *for the 8080*
- An S-100 Front Panel Replacement
- Home-Brew Z-80 System . . . *Part 2: CPU and memory board*
- Battleship!
- Improvements Make the Difference . . . *SWTP's new system*
- Simple and Low-Cost PROM Programmer
- Compatibility and the Altair Bus
- Retail Pricing System

August 1978

- DOCUFORM: A Word-Processing System for Everyone!
- Kilobaud Klassroom . . . *No. 11: Data and Address Buses*
- Software Debugging for Beginners
- Mits vs North Star
- Kansas City Standard . . . *at 1200 baud*
- Swords and Sorcery!
- Two Hobbies: Model Railroading and Computing, Part 2
- Update: Lunar Lander
- The Do-It-Yourself System . . . *Heath's H8 is a winner!*
- KIM + Chess = Microchess
- Is There Intelligent Life in Your Computer Room?
- From Base to Base . . . *with your HP 25*
- FINANC: A Home/Small-Business Financial Package
- Computer-Generated Signs
- Copying Computer Cassettes
- Something Extra With Radio Shack's BASIC
- The Amazing 1802
- Who Needs a UART?
- Can't Find It? . . . *an index for your SWTP BASIC manual*

September 1978

- (Con)text Editor
- At Last: A Client Timekeeping System
- Troubleshooters' Guide
- Metric-American Conversion Program
- The Heath/DEC Connection . . . *Part 1: overview*
- Home System Demo Program
- Do-It-All Expansion Board for KIM
- Tally Ho! . . . *fox and hounds game*
- Baudot Interface Cookbook
- Error-Correcting Techniques
- KIM Organ
- Kilobaud Klassroom . . . *No. 12: ROM and RAM memories*
- Motorola's Latest: The MC6802
- TRS-80 Update: Level II BASIC
- Super Cheap 2708 Programmer
- Something Extra in Mass Storage . . . *Meca's Alpha-1*
- From Big BASIC to Tiny BASIC

October 1978

- Budget System . . . *KIM, keyboard, TV, TVT-6L and AKIM*
- The Heath/DEC Connection . . . *Part 2: H11 system peripherals*
- Depreciation Calculations
- Looping in Tiny BASIC
- Kilobaud Klassroom . . . *No. 13: I/O Circuitry*
- Let Your Computer Wear a Watch
- Randomness is Wonderful
- Dazzler and BASIC
- The Latest in Operating Systems for the 6800: FLEX
- Action on the Enterprise
- Will DEC and IBM Be the Final Winners?
- Little Bits
- View from the Far East
- Use That Parity Line!
- The Software Patchcord
- A Useful Address List Program
- Ready for the Nuthouse?
- Build a One-Chip Single Stepper for the 6502

November 1978*

December 1978

- Dura/Itel Selectric for Low-Cost Hard Copy
- A "Gift" That Keeps on Giving
- The Art of Generating Expense Reports
- Deep, Dark Secrets of the TRS-80 (Level I)
- Interfacing the Elf II
- The Care and Feeding of Cassette Tapes, Part 1
- Kilobaud Klassroom . . . *No. 15: computer I/O III*
- Raster Scan Graphics for the 6800 . . . *Part 2: the software*
- SWTP 4K RAM Write Protect Option
- TSC Text Editor
- Spelling Bee
- Two Interface Boards from Teletek
- Attention, Chess Buffs!
- The Ups and Downs of Business
- BASIC Control of Servomechanisms
- There Is a Better MIKBUG!
- How to Write Good Application Programs
- Sharing Scheme for RS-232 Channels
- Scratched Diskette?

January 1979

- An Editor for 6800 BASIC Programs
- u-Panel for KIM
- Rolling Dice
- Pseudo Graphics
- The BCS and Its President
- Address List Editor
- Display Your PET!
- TRS-80 Tape Controller
- SHHH—People Are Sleeping
- Say It with a Banner
- Open House
- Cassette Interfacing
- PET Techniques Explained
- A Service Bureau for Hobbyists
- Little Bits
- Keeping Ma Bell Happy

February 1979

- Block-Structured Language for Microcomputers
- Kilobaud Klassroom, No. 16: I/O IV
- Computerized Climate Control
- Music, Maestro!
- Madam Dupre's House of the Zodiac
- Disk Power!
- Inventory Control with the TRS-80
- Onward with the COSMAC Elf!
- Build a $50 TVT!
- Percom's LFD-400 Floppy Disk System
- DOTS
- The Apple Speaks—Softly
- Super Mastermind
- TRS-80 Level II Reference Manual Index
- Care and Feeding of Cassette Tapes (Part 2)
- Text/Document Preparation Made Easy
- Simpler Interest
- Learn BASIC—with BASIC
- Use Flowcharts to Communicate
- Joystick Interface for Your Altair
- Attack on the Pack!

March 1979

- Cheap Video for Your Heathkit H8
- Analog and Digital Interfaces
- The "El Cheapo" EPROM Programmer
- Is Your Video Monitor Dangerous?
- Thoughts on the SWTP Computer System
- PET User Port Cookbook
- Chess Pawn
- Home Computer Exterior Ballistics
- Heath H9 Page Erase
- The SKIP II Microcomputer
- Ultra Banner
- Teletype's KSR-43
- The One Percent Forecasting Method
- Too Many Variables?
- Kilobaud Klassroom No. 17: I/O V
- The Electric Pencil
- How to Talk to Your 8080
- Programming the 1802
- Keyboard Interrupt for the TRS-80
- The OSI Model 500
- Sleep Better with a Microcomputer
- Telpar Thermal Printer

April 1979

- A Look at TRS-80 Peripherals
- Heath H8 Disk System
- DOTS (Part 2)
- Truly Random Numbers
- SWTP CT-1024 Mod
- Who Sells Software?
- How Important Is Proper Termination?
- How to Talk to Your 8080 (Part 2)
- Parallel Port to RS-232—Inexpensively
- Free Speech Lessons for the TRS-80
- Let's Go Flying
- Floppy Disk System from Tarbell
- The Wait State Explained
- Depreciation Analysis
- Twin Cassettes for Your TRS-80
- Bar-Graph Generator
- Let's Have Some Order
- Quicksort!
- Put Something Super in Your Life
- Starship Attack
- Terminate Your Troubles
- Testing PET Search Algorithms
- Two Diamonds
- How about a Printer?
- A Look inside the TRS-80

May 1979

- A Text Formatter in BASIC
- KIMCTR
- High-Speed Cassette Interface
- How to Talk to Your 8080 (Part 3)
- Data Base Management
- Analog and Digital Interfaces (Part 2)
- COSMAC Double Play
- COSMAC Double Play (cont.)
- From Microcomputer to Micro-Piano
- A Game of Darts
- Prettyprinting with Microsoft BASIC
- Kilobaud Klassroom No. 18
- MDOS
- A TRS-80 Cross-Index
- Graphing with the TRS-80
- An All-in-One Interface

June 1979

- "Monitor"
- TRS-80/Selectric Word Processor
- Thoughts on the SWTP Computer System (2)
- New Life for Our Altair
- TVBUG
- Creative Tabulation
- A Handle on Programming
- Keepbook
- Vector Graphing Techniques
- Putting the 1802 on the S-100 Bus
- A Personal Finance System (Part 1)
- Building a New Horizon
- Microcomputers and TVI
- Translating Between TTL and RS-232 Levels

***issues not available.**

. . . and more!

The Apple Goes to Market

Use of this program does not guarantee that you will become a Wall Street tycoon. What it will help you do, however, is gather and analyze data from the stock market.

Leslie R. Schmeltz
3224 Magnolia Ct.
Bettendorf IA 52722

Everyone, it seems, thinks he has a magical solution to the problem of timing purchases and sales in the stock market. The goal is obvious—buy stocks when prices are relatively low and sell them when prices are relatively high. Average investors (us so-called "odd-lotters") have a notorious history of doing just the opposite—buying with fervor at market peaks and selling in desperation when prices are bottoming out. Even investment professionals controlling millions of shares take their lumps by buying the right stock at the wrong time.

Since the stock markets are *exchanges*, for every transaction there must be a buyer and a seller. When prices are high and buying is hectic, there are sellers raking in handsome profits. After the euphoria wears off and prices are bottoming, here come those wise old sellers buying everything in sight. And so it goes—some winning, some losing.

Obviously, the market will not accommodate only winners. The problem is how to leave the herd of losers and enter the much smaller group of winners. Mind you, being a winner doesn't mean making a profit on *every* transaction, only a majority.

I acquired an interest in the stock market a few years ago while taking an adult education class on investments. The instructor, a stockbroker, admitted to having picked "a few duds," primarily due to poor timing. While I was discussing some ideas with my neighbor, also a stockbroker, he made the observation that once a stock price penetrated its long-term average (39 or 40 weeks) significant gains were likely to follow.

Armed with this pearl of wisdom, I searched the investment section of our local library, which was well populated with books on various techniques of market analysis and timing. Most of them, however, seemed geared to PhD's in accounting and ecomonics and required several hours a day studying charts and calculations.

The Art of Low Risk Investing by Michael G. Zahorchak (now in second edition, 1977, Van Nostrand Reinhold Co., 450 W. 33rd St., New York NY 10001—available in paperback) was refreshingly different. This book presented a strong case for investment management using moving averages for both general market trends and individual stock analysis.

On the basis of principles outlined by Zahorchak, I compiled a list of 96 stocks to follow, constructed an advance-decline line and collected 40 weeks' worth of price data on all 96 stocks plus the Dow Jones Industrial Average and the New York Composite Index. After several months of computing averages using my faithful Sears desk calculator, I began to search for a quicker, better and easier way. Three hours or so a week may not seem like much, but my ten thumbs on the calculator made it feel like an eternity.

Since I had access to the office HP3000 time-sharing system, a computer seemed the way to go. Only one slight problem: I knew relatively little (meaning nothing) about writing a program! Never one to let

```
  5 REM DATA LOAD PROGRAM--ARRAY A(1)--
    BY L. SCHMELTZ
 10 DIM A(1319)
 15 PRINT "INPUT ADVANCE-DECLINE FIGURES"
    :X=0:Y=14:GOSUB 500
 20 PRINT "INPUT DOW JONES INDUSTRIAL
    AVERAGE FIGURES":X=15:Y=54:GOSUB 500
 25 PRINT "INPUT NEW YORK COMPOSITE INDEX
    FIGURES":X=55:Y=94:GOSUB 500
 30 PRINT "INPUT (your stock 1)FIGURES":
    X=95:Y=134:GOSUB 500
 35 PRINT "INPUT (your stock 2)FIGURES":
    X=135:Y=174:GOSUB 500
                  See Text
175 PRINT "INPUT (your stock 30)FIGURES"
    :X=1255:Y=1294:GOSUB 500
180 INPUT "READY TO STORE ARRAY A(1)? (Y
    OR N)";B$
185 IF B$="N" THEN 180
190 STORE A
195 GOTO 520
500 FOR I= X TO Y: INPUT A(I): NEXT
510 RETURN
520 END
```

Listing 1. Data Load program.

details stand in my way, I read a few books on BASIC and began writing.

Lesson one in the fine art of programming soon became painfully apparent: First, define the problem and identify logical steps to solve it, then write the program! Once lesson one is learned, each step in the problem solution becomes a mini-program or subroutine of its own. Versions 2, 3, 4 and 5 were written and run on the HP, with each revision showing a better grasp of programming concepts.

Enter the Apple

Several months ago, after a year and a half of reading specs on various micros, I purchased a 16K Apple II with Applesoft II on ROM. It was cute, but could it handle the stock program with no disk and only 16K of RAM? The Applesoft manual looked promising—no MAT functions or disk files, but most of the HP BASIC capabilities seemed to be there.

Version A1 (A for Applesoft, you know) of the program was written and looked OK. One minor problem surfaced while I was typing it into the Apple—it would not fit in the memory! Version A2 divided the 99 items into three smaller programs and worked as intended.

This article describes the program as written in Applesoft and run with cassette files in 16K. While this particular application may or may not be of interest to you, perhaps some of the ideas presented could prove useful in similar applications. Each of the subroutines and the logic on which they are based will be described in detail, then integrated into the main program. From this, you should be able to construct a program to cover any number of stocks and adapt it to the file and memory capabilities of your system. Short programs to load data files and correct or replace selected data are included for convenience.

Why Write Your Own?

There are several excellent investment-management programs commercially available. The decision to write my own was based on several considerations:

1. Many available programs are primarily portfolio record-keeping systems. As such, they could be a valuable addition to your library for documenting transactions, profits and losses, yields, etc.
2. Some of the programs require more extensive system hardware than I have available.
3. The process of converting an application such as this to a usable program presents a real learning opportunity and challenge to your programming skills.
4. Understanding the logic on which the program is based helps considerably in revisions desired as interests change and more system capability is added.
5. It's fun!

Selecting Stocks to Follow

The process of stock selection is vitally important to later success using this investment approach. Several hours of research are required to choose suitable candidates from among the thousands of issues available. The following factors should be considered in selecting your own group of stocks.

1. Pick only stocks you would feel comfortable owning should a buy signal occur.
2. Diversify among industry groups and select only the strongest performers in each group.
3. Include only those stocks that show an annual price swing of at least 100 percent between high and low (commonly called volatile or cyclical stocks).
4. Daily trading volume must be sufficient to maintain ready liquidity.
5. Look for stocks traded on a major exchange so price information can be readily obtained.
6. Consider including a *few* special situation stocks, i.e., those companies who have shown temporary earnings, losses, takeover candidates, developers of new technology products.

Information necessary to make intelligent selections can be obtained from many sources: the public library, many major brokerage firms, periodicals (*Barrons, Forbes,* etc.) and books, to name just a few. Any company that particularly interests you will be happy to send copies of the annual report and other pertinent data.

Beware! There are numerous sources of information for making *dumb* investment decisions. Those who pass on "hot tips" may honestly feel they are doing you a favor. Maybe, maybe not! If the tipster were all that convinced about his discovery, he would be mortgaging the house, hocking the family jewels and selling his wife into servitude to raise enough funds to take advantage of this "once in a lifetime" opportunity—not trying to sell you on it!

The best place for a hot tip is usually on a soldering iron, but if you find it difficult to restrain yourself, investigate. Check out the stock and subject it to the criteria listed above. If, after careful scrutiny, you are still interested, then add the stock to your investment-possibilities list.

My personal preference leans toward stocks listed on the New York Stock Exchange because of the ease of obtaining market information. Our local cable TV system runs a 15 minute delayed "ticker tape" and news channel. While price information from Friday's closing is used to update the computer program, it is interesting to watch daily fluctuations when the market is developing a major trend.

Gathering Data

Once you have selected a reasonable number of stocks for your program, you will need weekly closing prices for the last 40 weeks on each. This in-

```
  5 REM PROGRAM TO CHANGE AND CORRECT DATA
    ARRAY--BY L. SCHMELTZ
 10 DIM A(1319)
 15 PRINT "LOAD THE ARRAY FROM TAPE AT
    THIS TIME"
 20 RECALL A
 25 PRINT: PRINT "TO CHANGE ALL THE
    ELEMENTS IN ONE STOCK FILE, TYPE
    'CHANGE'"
 30 PRINT: PRINT "TO VERIFY AND CORRECT
    A FEW ELEMENTS IN ONE STOCK FILE, TYPE
    'VERIFY'"
 35 INPUT B$
 40 IF B$="CHANGE" THEN GOSUB 100
 45 IF B$="VERIFY" THEN GOSUB 200
 50 INPUT "ANY MORE CHANGES OR VERIFICA-
    TIONS NEEDED? (Y OR N)";C$
 55 IF C$="Y" THEN 25
 60 INPUT "READY TO STORE ARRAY ON TAPE?
    (Y OR N)";D$
 65 IF D$="N" THEN 60
 70 STORE A
 75 GOTO 250
100 REM SUBROUTINE TO CHANGE ALL ELEMENTS
    FOR ONE STOCK
105 PRINT "INPUT THE NUMBER OF THE FIRST
    ELEMENT FOR THIS STOCK": INPUT X
110 PRINT "INPUT THE NUMBER OF THE LAST
    ELEMENT FOR THIS STOCK": INPUT Y
115 PRINT "INPUT THE NEW PRICES FOR THIS
    STOCK, MOST RECENT PRICE FIRST"
120 FOR I = X TO Y: INPUT A(I): NEXT
125 RETURN
200 REM SUBROUTINE TO CORRECT ERRORS IN
    STOCK PRICES
205 PRINT "INPUT THE NUMBER OF THE FIRST
    ELEMENT FOR THE STOCK YOU WISH TO
    VERIFY OR CORRECT": INPUT X
210 PRINT "INPUT THE NUMBER OF THE LAST
    ELEMENT FOR THIS STOCK": INPUT Y
215 PRINT: PRINT "AS EACH PRICE IS DISPLAYED,
    TYPE 'Y' IF CORRECT, 'N' IF INCORRECT"
220 PRINT: PRINT "AFTER AN 'N'RESPONSE, THE
    ? PROMPT ALLOWS YOU TO REPLACE THE
    INCORRECT FIGURE"
225 FOR I = X TO Y: PRINT A(I): INPUT "
    CORRECT?";E$
230 IF E$="N" THEN INPUT A(I)
235 NEXT I
240 RETURN
245 END
```

Listing 2. Change and Correct program.

formation can be obtained from charts such as *Trendline* (your broker may be able to lend you a copy) or periodicals. I found *Barrons* useful for this purpose since it publishes every Monday and includes Friday's closing prices for stocks on virtually every exchange. Most public libraries subscribe to *Barrons* and keep back issues on file for a year or so.

For the uninitiated, stock prices are quoted in fractions. While it is possible to gather and keep price data in reasonably exact decimal equivalents, rounding to the next highest full cent is certainly close enough for our purposes. (14 3/8 becomes 14.38, 14 5/8 becomes 14.63, etc.)

A simple sheet divided into columns for date and price is a big help in gathering the necessary price data. For my own situation, I made one master sheet and ran copies for each of the stocks I follow, plus one each for the Dow Jones and New York Composite Indexes.

Depending on the number of stocks you elect to follow, this data-gathering stage can range from tiresome to tedious. Hang in there, the worst is about over, and you can get back to your computer for the next few steps.

The Programs

Actually, the investment-management system includes three separate programs:

1. Data Load program—dimensions arrays, inputs price data and stores data on tape.
2. Change and Correct program—offers provisions to replace data for one or more stocks in the array, verify and correct only a few erroneous entries.
3. Main program—accepts current data on market and individual stocks, computes moving averages and totals, corrects for distributions and splits, recommends a course of action and updates the data files.

Memory limitations in my system do not permit running the 96 stocks I follow in one program. I have divided my main program into three sections and got an unexpected bonus in ease of handling the tape files (more on that later).

Calculating Advance-Decline Figures

To obtain the data necessary for constructing an advance-decline line, collect the last 15 weekly totals of prices that advanced and declined on the particular exchange that trades the majority of stocks you wish to follow. This information is often published in the Sunday edition of your local newspaper, as well as in *Barrons* and *Trendline*.

Once you have all the necessary information, the advance-decline figures may be calculated as follows:

1. For the *least* recent week, subtract the declines from the advances and add 20,000 to the total obtained (20,000 is an arbitrary figure used to keep the result a positive number). This is the figure you enter *last* in the advance-decline file.

2. For the next least recent week, again subtract the declines from the advances and add the difference to the figure obtained at the end of step 1. This becomes the next to last figure entered.

3. Continue as in step 2 for each succeeding week, each time adding the figure obtained

```
 10 PRINT "STOCK ANALYSIS PROGRAM--PART
    I": REM BY L. SCHMELTZ
 15 DIM A(1319): PRINT "LOAD ARRAY A AT
    THIS TIME"
 20 RECALL A
 25 INPUT "DATE (MM/DD/YY)?";A$: PRINT "
    D.J.I.A.": INPUT B: PRINT "N.Y.C.I."
    : INPUT K: PRINT "ADVANCES": INPUT E:
    PRINT "DECLINES": INPUT F
 30 X=0: Y=14: GOSUB 5800
 35 D$="DJIA": X=15: Y=19: GOSUB 5000:
    GOSUB 6000
 40 POKE -16368,0: WAIT -16384,128: WAIT
    -16384,1,1
 45 D$="NYCI": B=K: X=55: Y=59: GOSUB
    5000: GOSUB 6000
 50 PRINT
 55 PRINT "AT ? INSERT PRICE, 'SKIP', OR
    'SPLIT' FOR EACH STOCK": PRINT
 60 D$="AMR": X=95: Y=99: INPUT "AMERICAN
    AIRLINES?";E$
 65 IF E$="SPLIT" THEN GOSUB 9000
 70 IF E$="SKIP" THEN 80
 75 B=VAL(E$): GOSUB 5000: GOSUB 7000
 80 D$="(your stock 2)": X=135: Y=139:
    INPUT "(your stock 2)?";E$
 85 IF E$="SPLIT" THEN GOSUB 9000
 90 IF E$="SKIP' THEN 100
 95 B=VAL(E$): GOSUB 5000: GOSUB 7000
100 D$="(your stock 3)": X=175: Y=179:
    INPUT "(your stock 3)";E$
              See Text
660 PRINT: PRINT "PART I OF STOCK PROGRAM
    COMPLETED"
665 INPUT "READY TO STORE DATA ON TAPE?
    (Y OR N)";Z$
670 IF Z$="N" THEN 665
675 STORE A
680 PRINT "LOAD PART II OF PROGRAM"
685 GOTO 9030
```

Listing 3. Main program for market comments and analysis of 30 stocks.

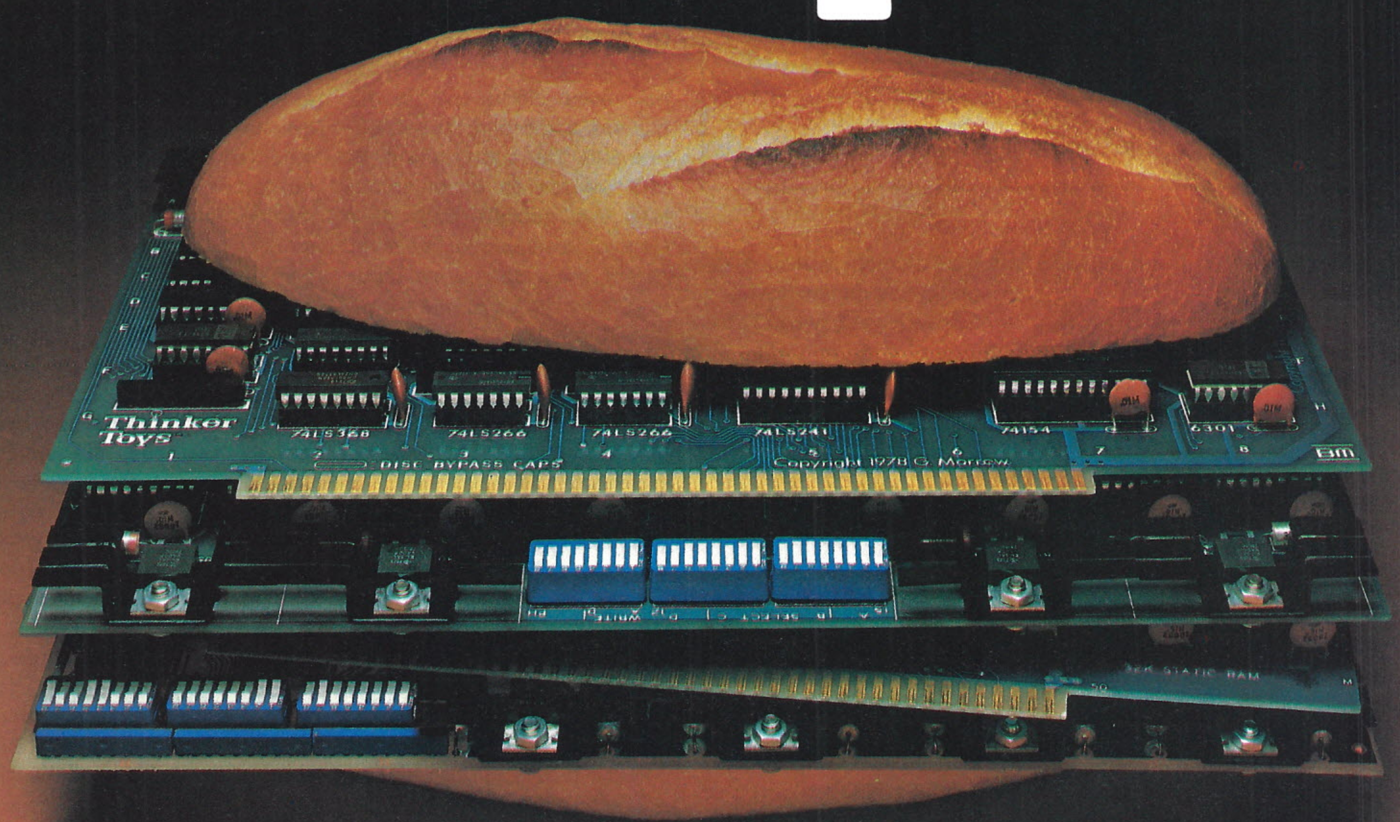
```
 710 PRINT "STOCK ANALYSIS PROGRAM--PART
     II": REM BY L. SCHMELTZ
 715 DIM A(1319): PRINT "LOAD ARRAY II AT
     THIS TIME"
 720 RECALL A
 725 D$="(your stock 31)": X=0: Y= 4:
     INPUT "(your stock 31)?";E$
 730 IF E$="SPLIT" THEN GOSUB 9000
 735 IF E$="SKIP" THEN 745
 740 B=VAL(E$): GOSUB 5000: GOSUB 7000
 745 D$="(your stock 32)": X=40: Y=44:
     INPUT "(your stock 32)?";E$
               See Text
1385 PRINT: PRINT "PART II OF STOCK
     PROGRAM COMPLETED"
1390 PRINT: INPUT "READY TO STORE ARRAY
     II ON TAPE?";Z$
1395 IF Z$="N" THEN 1390
1400 STORE A
1405 PRINT "LOAD PART III OF PROGRAM"
1410 GOTO 9030
```

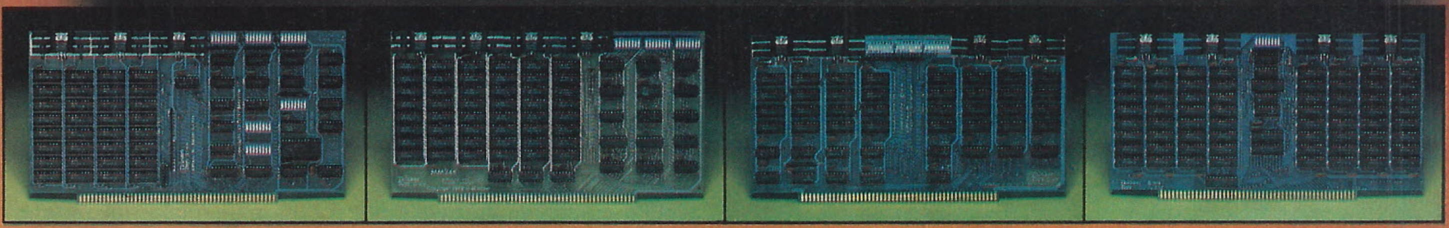
Listing 4. Main program for stocks 31-63.

```
5000 REM MOVING AVERAGE AND TOTAL
     COMPUTATION SUBROUTINE
5005 C1=0: C2=0: C3=0: C4=0: C5=0: C6=0:
     D1=0: D2=0: D3=0: D4=0: D5=0: D6=0:
     P=100
5010 FOR I = X TO Y: C1=C1+A(I): NEXT:
     C2=B+(C1-A(Y)): Y=Y+10
5020 FOR I = X TO Y: C3=C3+A(I): NEXT:
     C4=B+(C3-A(Y)): Y=Y+25
5030 FOR I = X TO Y: C5=C5+A(I): NEXT:
     C6=B+(C5-A(Y)): X=X+1
5040 D1=C1/5: D1=INT(D1*P+.5)/P: D2=C2/5:
     D2=INT(D2*P+.5)/P
5050 D3=C3/15: D3=INT(D3*P+.5)/P: D4=C4/15:
     D4=INT(D4*P+.5)/P
5060 D5=C5/40: D5=INT(D5*P+.5)/P: D6=C6/40:
     D6=INT(D6*P+.5)/P
5070 PRINT: PRINT TAB(5);"TOTALS";TAB(15);
     D$;TAB(22);"MOVING AVERAGES": PRINT
5080 PRINT "LAST 5 WK-";C1;TAB(20);"LAST
     5 WK-";D1: PRINT "5 WK--";C2;TAB(20);
     "5 WK--";D2: PRINT
5090 PRINT "LAST 15 WK-";C3:TAB(20);"LAST
     15 WK-";D3: PRINT "15 WK--";C4; TAB
     (20);"15 WK--";D4: PRINT
5100 PRINT "LAST 40 WK-";C5;TAB(20);"LAST
     40 WK-";D5: PRINT "40 WK--";C6;TAB
     (20);"40 WK--";D6
5110 FOR I = X TO Y STEP -1: A(I)=A(I-1):
     NEXT: X=X-1: A(X)=B
5120 RETURN
```

Listing 5. Moving Average and Total Computation subroutine.

2¢ a byte!





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```
5800 REM ADVANCE DECLINE SUBROUTINE
5805 H1=(E-F)+A(X): FOR I = X TO Y:
     H2=H2+A(I): NEXT: H3=INT(H2/15):
     X=X+1
5810 H4=INT((H1+(H2-A(Y)))/15): PRINT
     "ADV-DEC LAST-"; H3;"--CURRENT-"
     ;H4
5820 IF H4=>H3 THEN B$="UP"
5830 IF H4<H3 THEN B$="DOWN"
5835 PRINT "ADVANCE-DECLINE LINE---";B$
5840 FOR I = Y TO X STEP -1: A(I)=A(I-1):
     NEXT: X=X-1: A(X)=H1
5850 RETURN
```

Listing 6. Advance-Decline subroutine.

to the total from the previous week.

4. The last calculation made should be for the current week.

5. When entering the data to your program, enter the current week first, then last week, etc., until all 15 totals have been entered.

Data Load and Change Programs

The Data Load and Change programs will be used to input all your initial data to an array, which will be used later in the main program. Prior to actually inputting the program, decide what type and size the data array will be. My own program uses single dimension arrays of 1319 elements—large enough to accommodate 40-week price data for 33 stocks. (Don't forget, the 0 element is used in Applesoft II.) Assign file locations for your data as shown in Table 1.

Note that this array uses only 1294 of the 1319 elements dimensioned because you are using 15 week advance-decline figures instead of 40 week. The other sections of my program use all 1319 elements, so that figure is used for consistency. Applesoft II automatically fills the unused elements with zeros.

The second array, used with the second section of the main program, contains the 40 week data for stocks 31-63. A third array contains data for part 3 of the program and stocks 64-96.

Keep a separate written record of which array elements are used for each stock in your list. You will be referring to this list periodically to correct, update or replace data.

Listing 1 shows the Data Load program. Line 10 dimensions the array and should be consistent with the number of stocks you wish to follow times 40 minus 1. Lines 15-175 provide an input prompt, set X for the lowest element, Y for the highest, and branch to subroutine 500. The subroutine (500-510) creates an incrementing loop that accepts each data element in sequence. The most recent price should be input first, then work backward from there. Lines 180-190 prompt you that the array is ready to be stored. When your recorder is ready, respond with any letter but N, and the array will be stored on tape.

Listing 2 shows the Change and Correct program, which should be self-explanatory. Follow the prompts carefully and modify your data as desired. Be sure to dimension the array exactly the same as the Data Load program!

Once all your data is saved on tape files, you are ready to proceed to the main program.

The Main Program

Actually, the main program is little more than a traffic manager, prompting you to read and record tapes and input data where necessary and directing traffic to the subroutines. The subroutines handle nearly all the actual work done by the program, making it much easier to change a parameter here and there without having to type it several times.

Listing 3 lists a small portion of my main program, showing all the necessary functions to include in yours. Line 15 dimensions array A and must be the same as that used in the Data Load program. The system waits at line 20 for data from the cassette input. Once the data is loaded, line 25 prompts inputs for the initial information on market conditions for the week.

The advance-decline computations and comment are called from line 30. Note that X and Y are set to increment the FOR-NEXT loop in the subroutine.

Line 35 sets D$ to DJIA and calls two subroutines: Line 5000 is the subroutine that computes the 5, 15 and 40 week totals and moving averages for both the current and past week, prints the results and updates the data array. Note that X sets the lower element of the array, and Y must equal X + 4. The additional values of X and Y are modified in the subroutine as needed. Line 6000 is the subroutine that determines general market posture and prints a comment.

Line 40 is a programmed pause, giving you an opportunity to make notes on the Dow Jones market averages. Since I keep written records on the various averages, the pause keeps the results from scrolling off the screen before I have time to copy them. Hitting the space bar causes the New York Composite Index figures to be computed and displayed.

Line 60 sets D$ to the trading symbol for the first stock, X and Y for the subroutine loop, and prompts input of the current stock price, skip or split. American Airlines is used here as an example; your stock 1 and its trading symbol should be inserted here. If the stock has been split since last week, typing split causes the program to branch to subroutine 9000, which corrects the data array for the split, rounds the results and returns the price input prompt. The skip response is used when you no longer wish to follow the stock, or price information is not available at the time you run the program, and causes line 70 to advance the program to the next input statement.

This program assumes that if neither skip nor split has been entered in line 60, the current price will be contained in E$. Line 75 converts E$ to B and directs the subroutine 5000 to compute totals and moving averages and subroutine 7000 to produce a recommendation.

Lines 80-655 are the same as 60-75—one input line for each stock on your list and the skip line numbered to the next input line. Use as many of these four-line series as you need to cover

```
6000 REM MARKET SUMMARY SUBROUTINE
6005 PRINT D$;"---MARKET COMMENT, WEEK
     ENDING ";A$
6010 IF D4=>D6 AND D6=>D5 AND B$="UP" THEN
     C$="BULL MARKET---STAY INVESTED":
     PRINT C$: RETURN
6020 IF D4<D6 AND D6<D5 AND B$="UP" THEN
     C$="UNCERTAIN---AVOID NEW PURCHASES"
     : PRINT C$: RETURN
6030 IF D4=>D6 AND D6=>D5 THEN C$="UNCER
     TAIN---AVOID NEW PURCHASES": PRINT
     C$: RETURN
6040 IF D4<D6 AND D2<=D1 AND B$="DOWN"
     THEN C$="BEAR MARKET---AVOID NEW
     PURCHASES": PRINT C$: RETURN
6050 IF D2>D1 AND D2<D6 AND D4<D6 AND B$
     ="DOWN" THEN C$="5 WK UPTURN---BUY
     STRONGEST STOCKS": PRINT C$: RETURN
6060 IF D2=>D6 AND D4<D6 AND D6>D5 AND B$
     ="DOWN" THEN C$="BUY---BEAR RALLY OR
     EARLY BULL": PRINT C$: RETURN
6070 IF D2<D6 AND D4<D6 AND D6<D5 AND B$=
     "UP" THEN C$="BUY---BEAR RALLY OR
     EARLY BULL": PRINT C$: RETURN
6080 IF D2=>D6 AND D4<D6 THEN C$="BUY---
     SECOND BULLISH SIGN": PRINT C$: RETURN
6090 IF D2=>D6 AND D4=>D6 THEN C$="BUY
     AGGRESSIVELY---BULL MARKET AHEAD":
     PRINT C$: RETURN
6100 PRINT "NONE OF THE MARKET SUMMARY
     CRITERIA MET": PRINT "MARKET
     APPARENTLY UNCERTAIN": RETURN
```

Listing 7. Market Summary subroutine.

all the stocks on your list.

As noted earlier, this program as presently configured handles 30 stocks. If your list contains more than 30, Listing 4 shows part two of the main program for stocks 31-63. Parts three, four, etc., can be constructed using the same format. Subroutines 5800 and 6000 can be eliminated in parts two, etc., since the market information is needed only once.

As previously mentioned, dividing the main program into three parts has resulted in unexpected ease of handling the cassette files. I have recorded each part of the program on a separate cassette, followed by the data arrays used in that section. In using the tapes, I load the program first, then advance the tape to the most recent array and load it. The new, updated array is then recorded on the same tape following the array just read. (Keeping the last five or six arrays is a good backup procedure.) After part one is completed, load the tape for part two and use it in the same fashion.

Each section of the main program as shown here and its associated data array require approximately 12K RAM to run. If your system has more or less memory available, you may have to adjust the program and data array lengths to fit your system.

Subroutines

In Listing 5, subroutine 5000 computes the 5, 15 and 40 week totals and moving averages for both the current and past week. Line 5005 clears the variables for each total and average, since this subroutine is used repeatedly in the program. Line 5010 computes the past (C1) and current (C2) 5 week totals; line 5020 the past (C3) and current (C4) 15 week totals; line 5030 the past (C5) and current (C6) 40 week totals; and line 5040 computes the past (D1) and current (D2) 5 week moving averages and rounds the results to two decimal places. The 15 and 40 week figures are obtained in lines 5050 and 5060. The print lines 5070-5100 format and print the figures obtained on the 40 character Apple video display. The loop in line 5110 updates the data array.

Subroutine 5800 in Listing 6 provides calculations for the advance-decline line, prints totals from the past (H3) and current (H4) week, sets B$ for line movement and prints B$. B$ is also used in the market commentary subroutine to help determine general market posture. The advance-decline array is updated in line 5840. Note that the advance-decline figures are rounded to integers, sufficiently accurate for our purposes.

Subroutine 6000 in Listing 7 provides the logic necessary to supply a comment on the general market conditions. The relationship between the 5, 15 and 40 week averages and the advance-decline line determines whether or not new stock purchases should be considered at this time. Often the Dow Jones market comment will differ from the New York Composite's, probably because the Dow is more oriented toward the "blue chips." Use whichever comment you prefer, or wait till the two agree before investing. The general market summary is vitally important to this program of investment management, as we will see later.

If your BASIC does not permit multiple logic operators per statement, some revisions of this subroutine will be needed. This summary may be of help to you in understanding the logic on which the subroutine is based.

1. When both the 5 and 15 week averages are above the 40 week average and the advance-decline line is up, a bull market is thought to exist.
2. When the advance-decline line turns down or the 15 week average drops below the 40 week, the market is labeled uncertain.
3. When the advance-decline line is down *and* the 5 and 15 week averages are below the 40 week average, a bear market is assumed.
4. When *either* the advance-decline line or the 5 week average shows an upturn, strongest stocks may be considered for purchase.
5. When the 5 week average moves upward and penetrates the 40 week average, a new bull market is likely.
6. When the 5 week average stays above the 40 week average and the 15 week average rises to penetrate the 40 week average, a "buy aggressively" signal is flashed. Feel free to revise these criteria and modify the logic to fit your own particular situation.

```
7000 REM INDIVIDUAL STOCK ANALYSIS SUB
7005 IF D2=D1 THEN H$="NEUTRAL"
7010 IF D2>D1 THEN H$="UP"
7020 IF D2<D1 THEN H$="DOWN"
7030 IF D4=D3 THEN J$="NEUTRAL"
7040 IF D4>D3 THEN J$="UP"
7050 IF D4<D3 THEN J$="DOWN"
7060 IF D6=D5 THEN K$="NEUTRAL"
7070 IF D6>D5 THEN K$="UP"
7080 IF D6<D5 THEN K$="DOWN"
7090 PRINT: PRINT "40 WK - ";K$;" 15 WK -
     ";J$;"5 WK - ";H$
7100 PRINT
7110 IF D4<=D6 AND D2<=D6 THEN PRINT "
     AVOID REGARDLESS OF MARKET TREND":
     RETURN
7120 IF D4<=D6 AND D1<D5 THEN PRINT "5
     WK JUST PENETRATED 40 WK---": FLASH:
     PRINT "POSSIBLE BUY": NORMAL: RETURN
7130 IF D2<=D6 THEN PRINT "CONSIDER FOR
     PURCHASE ON 5 WK MARKET UPTURN":
     RETURN
7140 IF D2<=D4 THEN PRINT "HOLD IF BULL
     MARKET, SELL IF BEAR":RETURN
7150 PRINT "HOLD IF OWNED.  CANDIDATE FOR
     PURCHASE BETWEEN";D6;"- -";D2:
     RETURN
```

Listing 8. Individual Stock Analysis subroutine.

Subroutine 7000 in Listing 8 provides the individual stock analysis logic. Lines 7005-7090 determine and print the primary movement of each of the three averages.

The rest of the subroutine bases buy and sell judgements for individual stocks on the following criteria.

1. When both the 5 and 15 week averages are below the 40 week average, purchase of the stock is to be avoided.
2. When the 5 week average rises to penetrate the 40 week average, a "possible buy" signal is (literally) flashed.
3. When the 15 week average is above the 40 week average and the 5 week average is below, the stock becomes a candidate for purchase on a 5 week average general market upturn.
4. When both the 5 and 15 week averages are above the 40 week average and the 5 week average drops below the 15 week average, the recommendation is to hold in a bull market; sell in a bear.
5. When the 5 week average is above the 15 and 40 week averages and the 15 week average is above the 40 week average, the stock should be held or may be purchased as close to the 40 week average as possible.

In Listing 9, subroutine 9000 provides a means to adjust the data array for stock splits and distributions. To correct for a 2 for 1 split, use a divisor of 2; 3 for 1, use 3; etc. Once the array

```
9000 REM SPLIT AND DISTRIBUTION ADJUSTMENT
     SUBROUTINE
9005 PRINT: P=100: PRINT "DIVISOR FOR SPLIT"
     : INPUT S: Y=Y+35
9010 FOR I = X TO Y: A(I)=A(I)/S: A(I)=
     INT(A(I)*P+.5)/P: NEXT
9020 PRINT D$; "   ADJUSTED FOR SPLIT":
     Y=Y-35: INPUT "CURRENT PRICE?";E$:
     RETURN
9030 END
```

Listing 9. Subroutine for adjustment of splits.

```
]RUN
STOCK ANALYSIS PROGRAM--PART I
LOAD ARRAY A AT THIS TIME
DATE (MM/DD/YY)?2/9/79
D.J.I.A.
?822.33
N.Y.C.I.
?54.88
ADVANCES
?590
DECLINES
?1273
ADV-DEC LAST-22657--CURRENT-22805
ADVANCE-DECLINE LINE---UP

    TOTALS     DJIA    MOVING AVERAGES

LAST 5 WK-4200.09  LAST 5 WK-840.02
5 WK--4191.69      5 WK--838.34

LAST 15 WK-12286.67LAST 15 WK-819.11
15 WK--12302.95    15 WK--820.2

LAST 40 WK-33743.44LAST 40 WK-843.59
40 WK--33736.68    40 WK--843.42


DJIA---MARKET COMMENT, WEEK ENDING 2/9/79
BUY---BEAR RALLY OR EARLY BULL

    TOTALS     NYCI    MOVING AVERAGES

LAST 5 WK-279.95   LAST 5 WK-55.99
5 WK--279.42       5 WK--55.88

LAST 15 WK-813.19  LAST 15 WK-54.21
15 WK--815.55      15 WK--54.37

LAST 40 WK-2223.74 LAST 40 WK-55.59
40 WK--2224.65     40 WK--55.62


NYCI---MARKET COMMENT, WEEK ENDING 2/9/79
UNCERTAIN---AVOID NEW PURCHASES

AT ? INSERT PRICE,'SKIP',OR 'SPLIT' FOR
EACH STOCK

AMERICAN AIRLINES? 11.38
```

Listing 10. Sample runs.

has been adjusted and rounded to two decimal places, the current price is requested and the main program execution continues.

Your BASIC may not require an END statement; strictly speaking, neither does Applesoft II. I prefer using the END to getting the "break in line so and so" encountered with using a STOP before the subroutines.

Listing 10 shows sample runs of the complete market summary and one of the stocks I follow.

Adapting to Various BASICs

Applesoft II seems to be a reasonably universal floating point BASIC if you disregard the graphics capabilities. The FLASH command used in this program may be lacking in other systems, but none of the other graphics commands are used in this application. Arrays may be multidimensioned, if necessary, and strings could be converted to distinctive integers. A close study of the manual for your BASIC should clearly show any minor syntax differences needed to successfully run this program in your system.

How to Use the Information Obtained

Once you have gone through the many hours needed to gather data and get this program running, careful evaluation of the information obtained will likely increase your chances of investment success.

Watching the market indicators will give you a fair idea of when to buy stocks. During periods of market uncertainty or in a bear market, new purchases should be avoided. If you are inclined to speculate a bit, the strongest stocks (those with their 15 week average above the 40 week average) may be purchased during a 5 week market upturn. When the market turns more favorably, stocks may be purchased as their 5 week average penetrates the 40 week average or their prices dip close to the 40 week average.

Once a stock is purchased, the general market indicators are secondary to the individual stock analysis. A sell indication does not necessarily mean the stock will decline in price, rather that the possibility of a decline is high. Similarly, a hold or buy signal indicates possibilities of an increase in price.

The general purpose of this approach is to help you identify losers rapidly enough to sell with minimal loss and hold winners long enough to realize significant long-term gains. There are, however, no guarantees expressed or implied in this article. This program is not a substitute for good common sense in managing investments according to your own interests and abilities.

Getting Started

If you decide to try this approach to investing, I would suggest careful attention to the following:

1. Read as many books and articles as you can get your hands on, including the Zahorchak book mentioned earlier.

2. Monitor the program recommendations and make imaginary investments by recording your buys and sells on a sheet of paper. Review this record periodically to see what kind of results your approach is yielding. *Do not* commit actual funds at this stage!

3. Carefully analyze your own financial situation and set aside for investment only those funds you can comfortably afford to lose.

4. Once you have followed the results obtained long enough to get a feel for the signals and modified the program to fit your own situation, then try a few actual investments.

I have been following the same group of stocks for almost two years. During that time many of the signals flashed by the system have proven quite accurate, others only marginally so. My results of investing on paper have been generally good, but this is no guarantee yours will be the same. On those occasions I tried to second-guess the trend (and the computer program), disaster usually followed. The lack of emotions and inability to deal with anything but facts shown by the computer are a distinct advantage in the battle for investment profits!

Using the Program

Prior to using a computer, I spent approximately three hours per week locating current prices, calculating totals and averages and recording the results on sheets I prepared for this purpose. The computer has cut the time spent for all three steps to about one hour.

So far, the cassette files have proven dependable (excluding, of course, occasional operator errors such as forgetting to press "record" when saving an array!).

Summary

This article has presented one approach to investment management; there are many others that may be as good or better. Perhaps as important, a problem has been defined and a program written to solve it. While your success with investments may or may not be enhanced using this approach, the experience gained in programming will be invaluable.

I am looking forward to adding more capabilities to my system and programming such things as high resolution stock charts, option tracking, transaction records, etc. With any kind of luck at all, the Apple may help purchase some of the necessary goodies!

I would be interested in corresponding with any readers who have attempted similar programs or have questions regarding mine (SASE, please). If sufficient interest is shown, cassettes containing the program(s) and necessary data arrays for *your* list of stocks will be made available.■

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Let's Look at NEWDOS+

Even if you've upgraded to TRSDOS 2.2, NEWDOS+ from Apparat offers improvements.

H. S. Gentry
Rt. 1, Box 39B
Earlysville VA 22936

The Radio Shack TRS-80 Level II is a versatile and easy-to-operate microcomputer. However, its cassette program and data storage are slow and sometimes unreliable. But when this microcomputer is connected to one or more mini-floppy disk drives it takes on a new personality.

The TRSDOS disk operating system provided by Radio Shack makes the TRS-80 a fast and efficient software development tool. With it, you can write, save and load BASIC programs in a fraction of the time for cassette. However, the current version of this system has several serious problems.

Apparat, Inc., of Denver, Colorado, has a revised version of this disk system—NEWDOS+—that they claim has solved most of these problems. This article will review this new system.

First, let's look at sme of the major problems with TRSDOS 2.1 and what NEWDOS+ has done about them.

Disk Errors

TRSDOS occasionally makes read or write errors when transferring data to or from the disk. Apparently this is caused by enabled interrupts during disk read/write operations. NEWDOS+ disables interrupts during such operations. This seems to solve the disk error problem, but it does cause the real-time clock to lose about 0.12 seconds per operation. If this is too much loss for you, there are instructions with the system for reducing it to 0.01 seconds at the cost of longer disk I/O times.

Another problem with TRSDOS has to do with the handling of the disk directory. Both TRSDOS and NEWDOS+ maintain a disk directory. This directory is recorded on the diskette and tells the system where each file resides on the diskette. TRSDOS will (very infrequently) damage the directory while changing it. This causes loss of files and sometimes loss of all the data on the diskette. The NEWDOS+ has corrected this problem. I have lost data while using TRSDOS, but I have never lost data while using NEWDOS+.

System Problems

Several problems exist in the TRSDOS that do not relate to loss of data, but rather to functions that do not perform correctly. One of these system functions is APPEND. This program is supposed to attach one disk file to another to create a file consisting of the data from both files. This does not always work with TRSDOS, but it seems to work with NEWDOS+.

TRSDOS includes a function (VERIFY) that is intended to make the system check all data that is written on the disk. This function does not work correctly. The NEWDOS+ system corrects this error, and all data written on the disk may be checked.

Another problem that is fixed in NEWDOS+ has to do with the TRS-80 keyboard. Anyone who has used a TRS-80 for any length of time has had trouble with keyboard bounce. The bouncing of the contacts in the keyboard switches causes multiple characters for one keystroke.

Radio Shack has a debounce routine that can be used with TRSDOS to solve this problem. It must be loaded each time the system is loaded, and a portion of memory must be reserved for it. NEWDOS+ has a debounce routine built into it. If you don't need this debounce, instructions are provided to disable it at system start-up.

Extensions and Improvements

Some of the difficulties with TRSDOS have to do with limited capability rather than with errors. The NEWDOS+ includes many improvements on the TRSDOS procedures, as well as some entirely new procedures (that's the + in NEWDOS+).

BASIC Improvements

The big difference in NEWDOS+ BASIC starts as soon as you load it from the disk. With TRSDOS you type "BASIC," and after a few seconds the system requests the number of files and the memory size. With NEWDOS+ you type "BASIC X,Y,CMD," where X is the number of files; Y is the memory size; and CMD is any BASIC direct command.

All of this information is optional, except "BASIC." If you don't specify the number of files, you will get three; if you don't set the memory size, you will get all of memory; and if you don't include a CMD, none will be executed. With this procedure BASIC may be loaded and started with a one-line command, which may be the AUTO command on power-up. In this way, BASIC may be loaded on start-up, the files and memory can be set and a BASIC program can be loaded and executed.

With TRSDOS BASIC you can enter a few system-type commands with CMD"X," where X is a one-letter command. These commands are limited to turning the clock on and off, turning DEBUG on and exiting BASIC to DOS. If you are in BASIC and would like to display the disk directory, you are out of luck. You must exit BASIC, perform the system command "DIR," look at the directory and then return to BASIC. If you have a BASIC program in memory, it is lost.

Now for the good news! With NEWDOS+ you can enter any DOS command from BASIC. You type CMD"XYZ," where XYZ is the DOS command. For example, CMD"DIR" will display the disk directory. Even better news is that your BASIC program is not lost. In fact, if you stop a program with the BREAK key, you can continue it after the DOS command is finished. The DOS CMD may even be placed in a BASIC program.

For example, I have a nonstandard printer that uses a

```
10 REM DEMØNSTRATIØN PRØGRAM FØR REF
20 FØR I=1TØ100
30 J=I/2
40 K=I*2
50 L=I*I
60 M=L*J
70 PRINTI;J;K;L;M
80 GØTØ10
90 END
```

Listing 1a. Demonstration program for a BASIC cross-reference function.

```
  1  20
  2  30 40
 10  80
100  20
  I  20 30 40 50/2 70
  J  30 60 70
  K  40 70
  L  50 60 70
  M  60 70
```

Listing 1b. Cross-reference for Listing 1a. The first column is a number or variable referenced in the line numbers that follow in the next columns.

driver located in high memory. Any program that uses this driver has the instruction CMD"DVR" in it. When this BASIC instruction is encountered, the driver (located in DOS file DVR/CMD) will be loaded. I think that this is the best single feature of NEWDOS+.

NEWDOS+ BASIC has other improvements that make it easier to use. I will briefly touch on some of them. The BASIC commands LIST, EDIT and DELETE may be abbreviated L, E and D. A new command (OPEN "E") allows data to be added to an existing BASIC data file. This is not allowed with TRSDOS.

NEWDOS+ also provides a BASIC line renumber program (RENUM) and a valuable cross-reference function (REF) that will list variables referenced in the program and line numbers that reference them. Listing 1a shows a small BASIC program, and Listing 1b is the "REF" for that program.

Editor-Assembler

Radio Shack sells an Editor-Assembler (EDTASM) that is used to write assembly-language programs for the TRS-80. This program works fairly well but does not support the disk. NEWDOS+ solves this problem with a modified version of EDTASM. This version does everything the original EDTASM does as well as allow source files on the disk and output binary files to the disk.

The assembled program may be loaded into memory with the DOS command "LOAD," or if the file containing the program has the extension /CMD, it may be loaded and executed by typing the name of the file. This modified EDTASM makes writing special drivers, etc., for the TRS-80 a snap.

Copy, Backup and Format

TRSDOS 2.1 provides a diskette backup program that will copy one diskette onto another diskette for backup purposes. It also provides a copy program that will copy one file into another file. NEWDOS+ has done away with BACKUP and uses COPY to perform this function. One command will copy the entire diskette.

When this is done the destination diskette is not checked to see if it contains data. Copy will format and use it anyway. This means that you do not need to erase a diskette to use it for BACKUP. However, it also means that you will not be warned if the diskette contains data. This BACKUP procedure will work even if you have only one disk drive.

COPY has also been changed to provide several new copy functions, including the ability to copy files from one diskette to another even if you have only one drive. Several errors that cause TRSDOS COPY to malfunction have been corrected.

Both of these systems provide a FORMAT program. This program is used to place the necessary format information on a diskette to allow it to be used in a second (or third or fourth) drive. TRSDOS FORMAT will reject the diskette if it contains data, and requires that it be erased. The FORMAT in NEWDOS+ gives the user the option of formatting the diskette even if it contains data.

TAPEDISK vs LMOFFSET

TRSDOS provides a program called TAPEDISK, which will read a Level II system tape and record it on the disk. This allows assembly-language programs purchased for the Level II to be used with DOS. But in order to get the tape data onto the disk, TAPEDISK first loads it into memory. If the program loads into 4000H through 6FFFH, it may clobber part of TRSDOS before it can be placed on the disk.

The NEWDOS+ answer to this is LMOFFSET (load module offset). It will load a system tape (or a file already on the disk) and tell you where it should reside and its execution address. It will then ask for a new location. The program is moved to that location and a move routine is appended. It is then recorded on the disk.

Listing 2 shows an example of the use of LMOFFSET. The move routine or appendage may be left off if it is not necessary to relocate the program before it runs. The disable interrupts question refers to whether interrupts will be enabled or disabled when the program you are LMOFFSETing is run.

When the file created by LMOFFSET is loaded and executed, the move routine is activated and the program is moved to the original location and executed. This allows any program to be saved on the disk and loaded into the TRS-80. However, if the program uses memory assigned to DOS it will kill DOS.

DISASSEM

If you have ever wondered how the machine-language programs that make up BASIC or DOS work, then DISASSEM is for you. This NEWDOS+ program will disassemble any machine-language code. In other words, it will read the code and display (on the video screen or printer) the assembly language (Z-80) that will create that code. The program to be disassembled may be in memory (ROM or RAM) or in a file on the disk. Listing 3a is a brief assembly-language program assembled with EDTASM and stored on the disk in a file. Listing 3b is the DISASSEM decode of this file.

DISASSEM will tell you the innermost secrets of your TRS-80. I used DISASSEM to decode EDTASM and to find out why it would not work with my printer. I found that it used all of memory and therefore destroyed the printer driver. I then devised a patch to protect my driver and used LMOFFSET to make a new disk file with the patched EDTASM.

SUPERZAP

If you are inclined to try to make your own changes to the DOS, you will want to try SUPERZAP. You can use SUPERZAP to load, modify and replace

```
LMØFFSET
APPARAT LØAD MØDULE ØFFSET PRØGRAM, VERSIØN 1.1
SØURCE FRØM DISK ØR TAPE?  REPLY "D" ØR "T"?D
SØURCE FILESPEC?EDTASM/CMD
MØDULE LØADS TØ 5500-7639
MØDULE LØAD WILL ØVERLAP "CMD" PRØGRAM AREA (5200-6FFF)
ENTRY PØINT = 6F00
NEW LØAD BASE ADDRESS (HEX)?7500
SHALL APPENDAGE BE SUPPRESSED (Y ØR N)?N
MØDULE LØADS TØ 7500-9648
ENTRY PØINT = 963A
NEW LØAD BASE ADDRESS (HEX)? <ENTER>
INTERRUPTS TØ BE DISABLED (Y ØR N)?Y
DESTINATIØN FILESPEC?NEWASM/CMD
MØDULE WRITE CØMPLETED
"ENTER" TØ RESTART PRØGRAM ANEW?
```

Listing 2. Use of LMOFFSET to move the Editor-Assembler to a new memory location, attach a move appendage and store it on the disk with a new file name. Data underlined was input by user.

```
                00100 ; DEMØNSTRATIØN ASSEMBLY LANGUAGE PRØGRAM
                00110 ;
0A7F            00120 ARG     EQU     0A7FH
4012            00130 LØCA    EQU     4012H
FCA8            00140 LØCB    EQU     0FCA8H
4013            00150 LØCC    EQU     4013H
0A9A            00160 BACK    EQU     0A9AH
7F7B            00170         ØRG     7F7BH          ;SET LØCATIØN
7F7B F3         00180         DI
7F7C CD7F0A     00190         CALL    ARG            ;FETCH ARGUMENT
7F7F AF         00200         XØR     A              ;CLEAR A
7F80 B5         00210         ØR      L
7F81 280E       00220         JR      Z,EXIT         ;GET ØUT
7F83 ED56       00230         IM      1              ;SET MØDE
7F85 3EC3       00240         LD      A,0C3H
7F87 321240     00250         LD      (LØCA),A
7F8A 21A8FC     00260         LD      HL,LØCB
7F8D 221340     00270         LD      (LØCC),HL
7F90 FB         00280         EI                     ;TURN IT ØN
7F91 C39A0A     00290 EXIT    JP      BACK
0000            00300         END
00000 TØTAL ERRØRS

ARG     0A7F 00120   00190
BACK    0A9A 00160   00290
EXIT    7F91 00290   00220
LØCA    4012 00130   00250
LØCB    FCA8 00140   00260
LØCC    4013 00150   00270
```

Listing 3a. Sample program assembled by EDTASM.

any data on any sector of the disk. This program does not use the system I/O programs and will read anything on the disk, protected or not. SUPERZAP will also perform a disk backup, but it is very slow and requires two disk drives. It will sometimes read a defective diskette and recover data that would otherwise be lost.

NEWDOS+ has many more features than I can discuss in detail here. Two of them are a revised disk directory printout and the ability to print the contents of the video screen on the printer (simulates the screen printer). If you think I like this operating system you are right. It is a great improvement over TRSDOS 2.1, but NEWDOS+ does have a few unique problems.

For example: TRSDOS has a real-time clock that will maintain the time, day, month and year. NEWDOS+ only maintains the time. I have a program that uses the clock, including the day, month and year, and was forced to rewrite this program to include the logic for the calendar.

The TRSDOS has a device command to print the list of I/O devices. This is disabled in NEWDOS+ (big deal).

Probably the most significant problem with NEWDOS+ is its incompatibility with Microsoft FORTRAN. This package works well with TRSDOS but will not work with NEWDOS+. The object files created by this FORTRAN cannot be loaded by NEWDOS+. I have been told that disk Electric Pencil will not work with NEWDOS+, but I have not verified this.

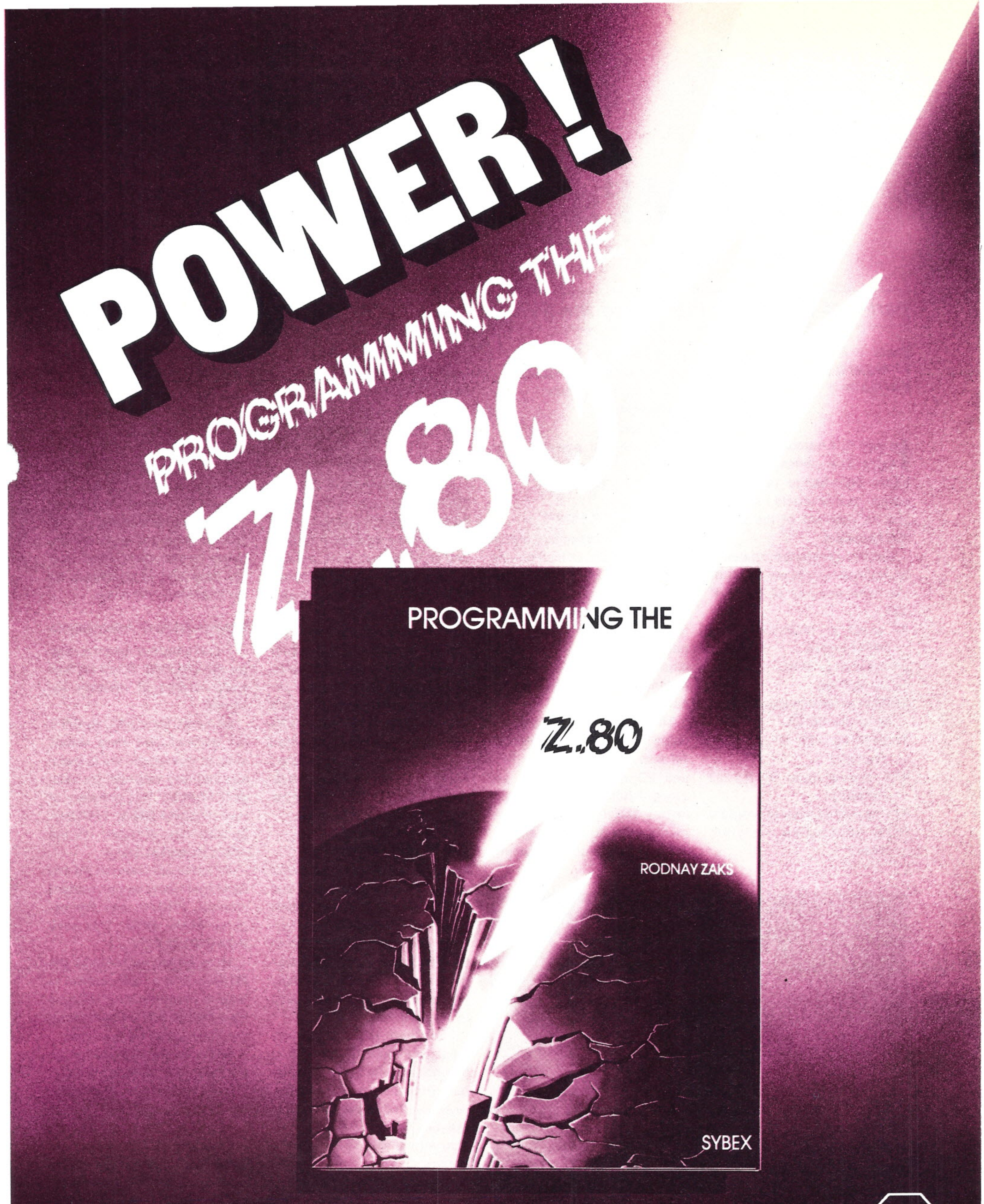
The NEWDOS+ system comes on one diskette and occupies almost all of that diskette. In this form there is almost no room for user programs or data. However, this diskette may be copied, and programs that you don't use may be deleted. The documentation supplied with the system tells you exactly what each system program does and when it is needed. With this information you can make the system very small and leave maximum disk space for your programs.

As long as we are talking about documentation, let's discuss the manual that comes with NEWDOS+. Apparat, Inc., does not supply general operating instructions for the system. What they supply are instructions for everything they have changed or written. They require that you purchase TRSDOS and EDTASM from Radio Shack to get the complete instructions for their operation. This is the only attempt that they make to protect Radio Shack's copyright and see that Radio Shack is paid for your use of their system.

Apparat, Inc., sells NEWDOS+ on an "as is" basis and makes no guarantee that it will work properly. However, I have been using it for some time and have found no errors or problems other than those already mentioned.■


```
  7F7B F3         DI
  7F7C CD7F0A     CALL  0A7FH
  7F7F AF         XØR   A
  7F80 B5         ØR    L
  7F81 280E       JR    Z,7F91H
  7F83 ED56       IM1
  7F85 3EC3       LD    A,0C3H
  7F87 321240     LD    (4012H),A
  7F8A 21A8FC     LD    HL,0FCA8H
  7F8D 221340     LD    (4013H),HL
  7F90 FB         EI
I 7F91 C39A0A     JP    0A9AH
```

Listing 3b. DISASSEM of Listing 3a.


POWER!
PROGRAMMING THE
Z 80
PROGRAMMING THE
Z.80
RODNAY ZAKS
SYBEX

AMI's EVK Series

Part 1 of this series introduced the EVK microcomputers. Part 2 looks at the hardware.

David. L. Tietz
21 Rainetta Dr., Rte. 3
Eau Claire WI 54701

In part 1, I introduced you to AMI's EVK series of single-board 6800-based microcomputers. In this article I will give you an overview of the EVK's 300 hardware.

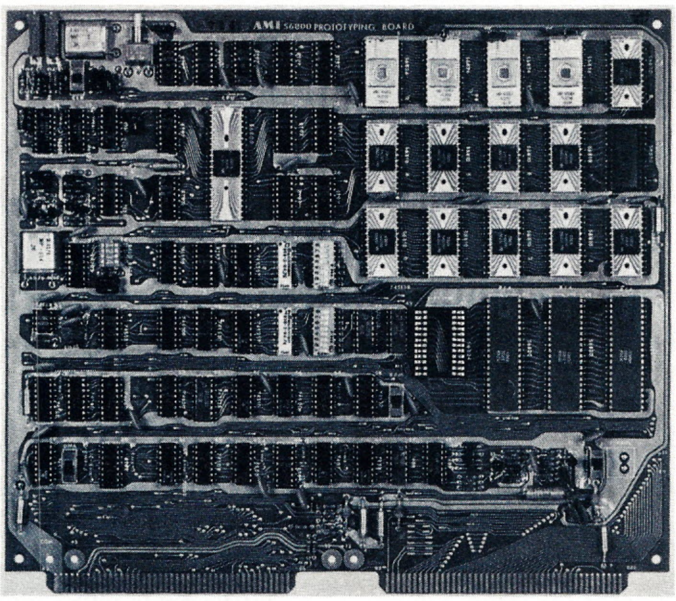
Before I get started, however, let me quickly review some of the main features of the EVK 300:

2K bytes of ROM (4K using S6831 ROMs)
2K bytes of EPROM
1K bytes RAM
EPROM programming capability for the S6834
Three PIAs with 58 I/O lines available
TTY current loop or RS-232 interface
TTY operating system program
ROM subroutine program library
Totally buffered MPU lines
Restart address selection
Selectable DMA mode
Interval timer
Tiny BASIC
Single +5 volt power supply, except when EPROMs or RS-232 is used.

Board Size and Layout

AMI designed the EVK 300 on a single 10 1/2 × 12 inch printed circuit board. Two edge connectors are available: One is used for the MPU bus, the other for I/O. Each connector contains 43 pins each side, or 86 pins total. They fit a standard Amphenol P/N 225-805-43 connector or equivalent.

The EVK 300 can be operated using only the I/O connector. All of the board's power, ground and I/O connect circuits are brought out through that connector satisfying the requirements of a minimum system. The bus connector is basically used for expanding the system to add more memory or control lines. There is some support hardware available for the EVK 300, which I'll touch on later.



Power Supply Requirements

The general logic of the EVK 300 requires only +5 volts at approximately 3.5 Amps to run (with TTY current loop interface and no EPROMs). Both +5 and −12 volts are required when EPROMs are used, and are also required for RS-232 interfacing. The current requirements are 150 mA for the −12 volt supply and 25 mA for the +12 volts. The on-board EPROM programmer uses −50 volts at 35 mA for programming. Lead wire holes are provided in the board for soldering wires carrying +5 volts, ±12 volts and ground directly to the board without going through the connectors.

System Description

Fig. 1, taken from the *Prototyping Board Manual* supplied by AMI for the EVK 300, shows the block diagram for the system. It's a good illustration of the MPU and its various support circuits and especially points out the three buses used by the EVK 300.

First there is the MPU's address and data bus, which is brought into the first set of buffers. This, then, becomes a buffered set that is brought out to the bus edge connector and also into a second set of TTL buffers.

Through the second set of TTL buffers, there is the system bus that the support circuits use. The MPU bus is isolated to keep signal loading to a minimum. The system bus is isolated to prevent the on-board memory and the I/O devices from loading down the external MPU bus at the bus edge connector. This allows 40 mA of drive current for external expansion hardware. The bus logic is the same on all three buses (logic true = voltage high = "1"). The address bus controls are gated by the DMA grant line; the data bus is controlled by the DMA and R/W lines.

Memory Address Assignments

Fig. 2 shows a memory map for the EVK 300. There are five major blocks of memory assigned.

2K bytes from E000 to E7FF (all address and data values used in this article are in hexadecimal) are reserved for resident EPROM. This consists of four 512-byte S6834 EPROMs. Sockets are provided on the board to accept these.

4K bytes are reserved for the ROM that would be the resident monitor, PROTO, and the optional MA/D ROM. This runs from E800 to F7FF.

1K bytes are set aside for the I/O (which in a 6800 system is treated like memory). This runs from F800 to FBFF. Fig. 3 shows the I/O address assignments.

1K bytes are reserved for upper RAM. Half of this is fixed at the uppermost part of memory from FE00 to FFFF. This is the scratchpad that PROTO uses for register storage and stack area. The other 512 bytes are movable from FC00 through FDFF to 0000 through 01FF. AMI's philosophy here is that if only on-board RAM is used, zero page memory will be avail-

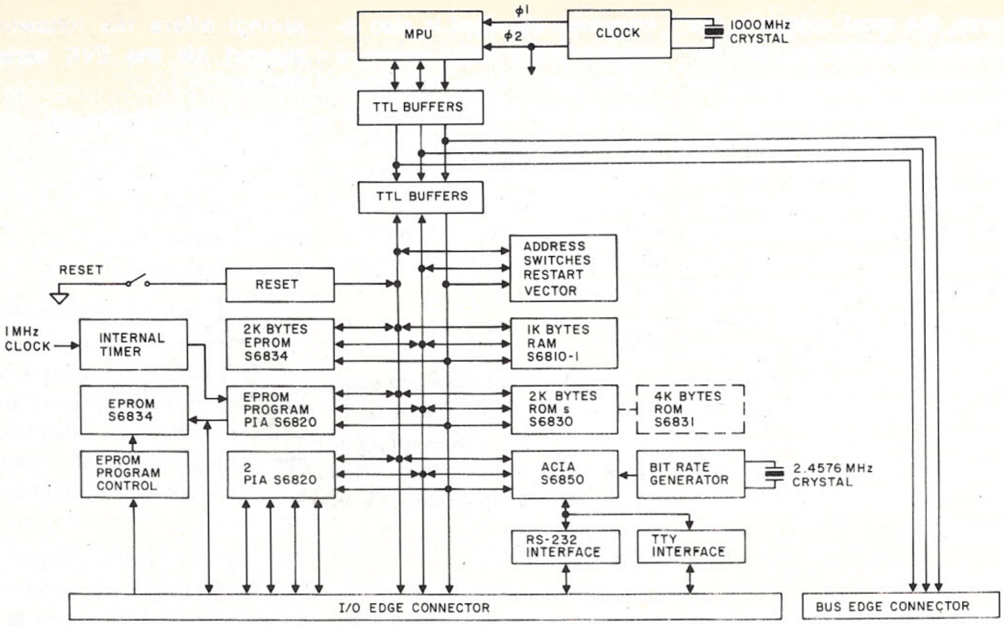


Fig. 1. EVK series board block diagram. (All figures and photo courtesy of American Microsystems, Inc.)

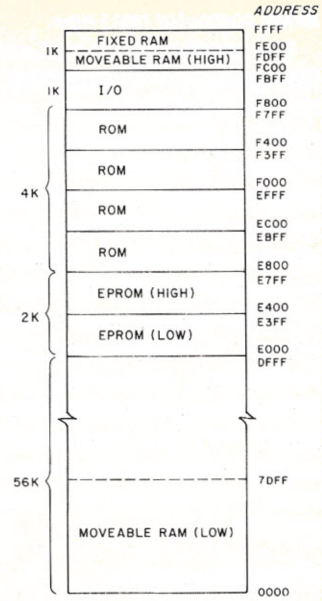


Fig. 2. Memory map.

able. This allows use of the 6800's direct mode commands.

If more memory is to be added, the zero page can be moved up out of the way into high RAM. AMI makes the address assignments so that all the components on the card can run in the upper 8K of memory. This allows 56K of continuous RAM on the system.

In practice, approximately 800_{10} bytes of the on-board RAM can be used by the programmer. This permits an ample push-down stack. I haven't found this to be any great problem in developing my software, because, as I mentioned in part 1, a lot of subroutines can reside in EPROM. In addition, use of AMI's RS³ subroutines saves a lot of memory. A memory disable line is available to the bus edge connector. This line, when low, disables all I/O and memory devices on the board.

I/O

Because AMI designed the EVK series for prototyping, they provided lots of parallel I/O. Three PIAs are supplied with the EVK 300. The four ports and the eight control lines of two of the PIAs are brought directly out of the bus edge connector. The third PIA is used by the EPROM programmer circuit. Two of its control lines are inaccessible to the user, but the remaining six and the four ports are wired to the programming socket and the I/O bus connector.

During the programming of an EPROM, the user loses control of any external circuitry attached to these 18 lines. All 58 I/O lines from the three PIAs are unbuffered. Unlike MIKBUG, PROTO uses a 6850 ACIA to communicate with peripherals. This allows a much faster throughput, because no computer time is used to convert parallel data to serial data. AMI realy has a better idea here.

A crystal-controlled baud rate generator generates all the standard communcation rates from 110 baud to 19,200 baud. This is independent of the system clock, so the MPU speed can be changed without affecting serial I/O. These baud rates are set with the bit rate generator switch located on the board. This is the 4-bit DIP switch, and Fig. 4 shows the switch settings for the corresponding baud rates. An RS-232 interface and a 20 mA current loop interface are available at the I/O edge connector.

Clock

The system clock is a 96502 dual one-shot connected in a regenerative feedback loop. The clock can run from approximately 300 kHz to 1 MHz—Ø1 and Ø2 are adjustable. AMI provides a 1 MHz crystal frequency standard that can be switched into the Ø1 circuit to control timing accuracy. Ø1, Ø2 and the 1 MHz standard are all buffered and available at the bus edge connector.

Reset/Restart

A reset circuit provides a 200 ms reset pulse for power-on reset or activation of the reset switch. A small reset switch is provided on the board, or the user may provide a remote switch through the MPU bus edge connector. AMI has a convenient restart feature that allows the EVK 300 to be a stand-

I/O Port	Address	Assignment
S6850 ACIA		Serial I/O—TTY
	FBCE	Status/Read
	FBCF	Control/Write
S6820 PIA 1		Unassigned
	FBC8	Peripheral Register A
	FBC9	Control Register A
	FBCA	Peripheral Register B
	FBCB	Control Register B
S6820 PIA 2		Keyboard/Unassigned
	FBC0	Peripheral Register A
	FBC1	Control Register A
	FBC2	Peripheral Register B
	FBC3	Control Register B
S6830 PIA 3		PROM Burner
	FBC4	Peripheral Register A
	FBC5	Control Register A
	FBC6	Peripheral Register B
	FBC7	Control Register B

Fig. 3. I/O assignments.

SW Position 4	3	2	1	Bit Rate
0	0	0	0	19,200 baud
0	0	0	1	0 baud
0	0	1	0	50 baud
0	0	1	1	75 baud
0	1	0	0	134.5 baud
0	1	0	1	200 baud
0	1	1	0	600 baud
0	1	1	1	2,400 baud
1	0	0	0	9,600 baud
1	0	0	1	4,800 baud
1	0	1	0	1,800 baud
1	0	1	1	1,200 baud
1	1	0	0	2,400 baud
1	1	0	1	300 baud
1	1	1	0	150 baud
1	1	1	1	110 baud

Fig. 4. Baud rate switch settings.

alone computer *right now*.

The starting address of any 6800 system is FFFE and FFFF. Each time the MPU is reset, the contents of these two memory locations are loaded into the *program counter*. The EVK 300 ignores the FFFE/FFFF addresses and puts the contents of two 8-bit switch sets on the data bus during restart. The memory is disabled, and one switch set is gated during the FFFE time and the second during the FFFF time. Thus, restart address in memory may be selected by the use of these switches.

EPROM Programmer

For all of the EVK 300's features, the most unique is the on-board EPROM programmer. A zero-force socket accepts the S6834 EPROM, and PROTO has three commands dealing with the programming of the EPROMs. Any number of memory locations of the 512 may be programmed at one time. Even a single bit in any memory location may be set from 0 to 1. Before the EPROM is removed from the socket, the contents may be verified to ensure the data was accepted. A switch is provided on the board to turn the −50 volts on or off for programming.

Interval Timer

The above-mentioned 1 MHz frequency standard is also divided into two timing pulses, a 100 us and a 1 ms. These are used by the EPROM programmer but are also available to the user. Bit 7 of control register A (PIA-3) gets set by the 1 ms pulse, and bit 7 of control register B (PIA-3) gets set by the 100 us pulse.

DMA

Three types of DMA are supported by the EVK 300 board: multiplex, halt processor and cycle steal. A switch on the board selects the mode.

Support Hardware

Advanced Computer Products (see their ads in *Microcomputing*) offers the following support for the EVK series boards:

- Universal kludge board
- 16K byte RAM board
- Six-slot motherboard
- Extender board
- Solid frame chassis
- Frame chassis

Also, I have seen a reference to a video board in a few ads, and Tiny BASIC is available on EPROM. I haven't yet used any of these options, so, other than mentioning they exist, I can't give you an opinion of their performance.

In Part 3, the concluding article, I'll describe AMI software support for the EVK series. ■

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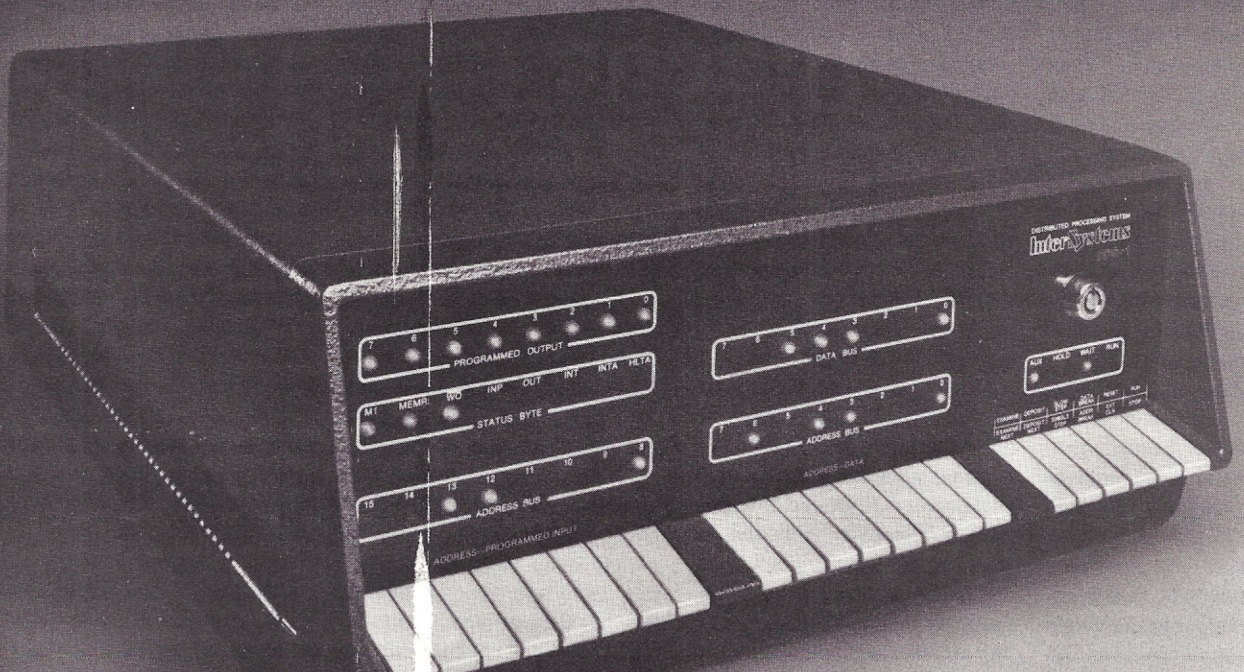

Thoughts on the SWTP Computer System

This installment takes a more in-depth look at the Percom LFD-400 disk system.

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In part 1 of this article, we examined the characteristics of the SWTP MF-68 and the SSB BFD-68 disk systems for the SWTP 6800 system. This month we will conclude this two-part series with a look at the Percom LFD-400.

The Percom LFD-400

The Percom disk system is quite different from the others, both in hardware and in software. The basic system consists of a small single-drive cabinet, power supply, drive, cable, controller, a DOS called MINIDOS and a batch of "technical memoranda," which give patches for adapting existing software to run on the system. At $600 for the package, this is the least expensive SWTP-compatible disk system there is.

But there are various ways to expand the basic system as time goes on—by adding a second drive and by adding more software. When this is done, the system becomes more expensive than a comparable SWTP system and approaches the price of the SSB disk system.

Let's look at the hardware first. The controller is a large board that plugs into the 50-pin main bus of the computer. Unlike the other two disk systems, this one does not use the 1771-01 disk controller IC; it uses an AMI S2350 USRT (universal synchronous receiver-transmitter). The USRT handles the serial-to-parallel conversion and synchronous data-transfer protocol for the disk, but additional hardware and software are needed to handle some of the functions normally handled by the 1771-01 chip in the other systems, such as keeping track of where the head is on the disk and so on. Thus this controller is more complex than even the Smoke Signal controller; it has 27 ICs.

There is room on the controller board for three 2708 EPROMs, which are addressed at memory locations C000, C400 and C800. The controller also uses addresses CC00 through CC06 for I/O. Hence the controller just about uses up the 4K address block from C000 through CFFF, which creates some problems for owners of newer systems who want to use that area for 2716 EPROMs on their CPU board. (This is not as much of a liability as it seems though; it is possible to move the entire board from the C000-CFFF area down to 9000-9FFF and release at least some of the C000 address space for 2716 use.)

The Percom disk uses 10-sector hard-format diskettes. Hard sectors allow more data to be squeezed on the disk than soft sectors: There are 35 tracks with ten sectors each; the resulting 350 sectors each have 256 bytes, so that the total disk capacity is 89,600 bytes, about 18 percent more than the 75,888 bytes of the SWTP soft-sectored format. A hard-sectored disk also does not have to be formatted prior to use, which saves a few minutes for every new disk.

On the other hand, data is always stored on consecutive sectors, starting from the outside of the disk. There is no provision for splitting a file into pieces so they will fit into available sectors. When a file is removed from the disk, it leaves a hole.

Percom offers three different disk operating systems: MINIDOS, MINIDOS-PLUSX and INDEX. Let's look at them one by one.

MINIDOS is the simplest and is included in the price of the basic disk system. It is completely contained on one 2708 EPROM and occupies addresses from C000 to C3FF. It uses addresses 0000-001F for a single FCB and also uses the upper portion of the MIKBUG/SWTBUG RAM (from A07F down) for a stack; this portion of RAM is normally unused by the monitor, so there is no conflict. Moreover, addresses 0000-001F are normally not used by other software, so MINIDOS will work in a system without any need for an additional 4K memory, such as the other disk systems require. It would work perfectly well even on an old SWTP system with only 2K of memory (do you remember that far back?).

Since the entire MINIDOS is contained in an EPROM, there is no booting required—you simply jump to location C000, and there it is. Since SWTBUG has the Z command to do just that, starting up the Percom disk is easy. Moreover, since there is no space taken up on the disk for a DOS or directory, the full 89K bytes on the disk can be used for files.

On the other hand, MINIDOS is a Spartan DOS. It does not maintain a directory of any kind. The 350 sectors are numbered 000-349, and it is up to you to keep a written record of what is where on the disk. In this sense, MINIDOS is like a fast cassette. All it can do is save and load chunks of memory. It has only two commands: S and L. To save a program, you might give MINIDOS the command

```
S 0100 1DB0 0100 1030.
```

This command tells MINIDOS to save the contents of memory locations 0100 through 1DB0 on the disk, starting at sector 030 of drive 1, and assign the program a starting address of 0100. MINIDOS then proceeds to write the contents of those memory locations on the disk and prints out the number of the last sector when done. It is up to the user to keep track of the sectors used, so that the program is not overwritten at some later time.

MINIDOS does not allocate disk file space in any way—it simply starts storing at the sector specified in your S command and takes up as many sectors as needed. It uses consecutive sectors and keeps no directory. This makes it fast—saving or loading programs takes a half to a third of the time of other disks.

But to fit into a 1K EPROM, MINIDOS is simple. You just can't compare it with FLEX or DOS-68. There is little facility for tying it into other programs or storing data files. It is strictly intended for storing programs.

It is not character oriented but transfers whole blocks of memory to and from the disk. It is simply a fast cassette replacement—it will dump 16K of memory to disk in 8 seconds and load it back in 5 seconds.

The next step up is an operating system called MINIDOS-PLUSX. It also comes in a 2708 EPROM and mounts in the second EPROM socket on the disk controller board, occupying addresses C400-C7FF. (This leaves the third EPROM socket empty, and you can use it for your own purposes.) PLUSX is now included in the system price. It includes the 2708, a diskette with a complete source and object listing of PLUSX and four disk utilities. (Supplying source code on diskette is a Percom specialty—they do it for most of their system software. I wish more manufacturers did that!)

In addition to the ROM, PLUSX requires 256 bytes of RAM starting at address A080, but versions are available to run with the area located at 7080 also. (But with the source code, you can reposition this almost anywhere.) For compatibility with other software, though, it is best not to move this area. This essentially requires that you disable the 6810 RAM on the CPU board (easy with the MP-A2 CPU board) and substitute a separate memory board. Since only memory from A000 through A180 is needed, a 4K board with only 1K worth of 2102s would be an inexpensive and easy solution.

MINIDOS and MINIDOS-PLUSX have to be used together; that is, you need both 2708s plugged in at the same time. But MINIDOS is so set up that, when you jump to it with SWTBUG's Z command, it tests to see whether MINIDOS-PLUSX is plugged in. If it is, it jumps to it. Hence, booting still involves only typing a Z into SWTBUG.

MINIDOS-PLUSX uses a file directory that occupies the first ten sectors (first track) on the disk. Each file gets a name of up to six characters; if the first character of the name is an at-sign, the file becomes protected and cannot be erased or written over.

Each PLUSX command is a single letter; the commands are:
I—initialize the diskette directory.
S—save a region of memory to diskette.
A—add ten sectors to the end of the last line.
L—load a file from disk back into memory.
F—list the directory.
R—rename a file.
D—delete a file.
J—jump to an address.
X—exit to MIKBUG or SWTBUG.
M—go to MINIDOS.

In addition, four disk-utility commands are provided on diskette:
BACKUP—copy full tracks from one disk to another.
COPY—copy a file from one disk to another.
CREATE—allocate disk space for a file and place its name in the directory.
PACK—pack the files on a disk to close up empty holes between them.

PLUSX is structured at a more fundamental level than either FLEX or DOS-68. In addition to the more familiar linkages to user software, various subroutines are available for total disk control. A jump table is located at the beginning of the MINIDOS area, but no entry points are provided to the PLUSX directory handler. Thus, the user can use the jump table to access mundane I/O functions but has to piece through the PLUSX software to figure out how to link to it. (Fortunately, Percom supplies the commented source code.)

Space on the diskette is allocated using a "go to the end of the line" scheme. This means that any new space allocations (not old files to be overwritten) will be placed at the end of all previous files on the diskette. If a file is deleted, its space may not be reclaimed until the diskette is packed with the PACK utility. The sectors within a file are chained together, but empty sectors are not.

Although dynamic allocation of disk space is convenient, the fragmenting of disk files into pieces that are spread out all over the disk has one big disadvantage (aside from its slowing everything down). Accidents do happen. Sometimes, because of operator error, sheer stupidity or accidents, something happens to erase part of a disk —a single file, part of the directory or perhaps just a sector or two. With a dynamic-allocation scheme, it becomes a major job to try to rescue the rest of the disk. Just finding out what's where is a major job. But with a single-minded scheme such as Percom's, it's a simple matter to examine disk contents sector by sector and reconstruct at least some of the files. They even provide a DSKMAP program to do just that.

The most advanced Percom DOS is called INDEX; unlike MINIDOS and MINIDOS-PLUSX, INDEX comes on a diskette rather than being in ROM. As supplied, one diskette contains a MINIDOS- or MINIDOS-PLUSX-compatible dump of INDEX, while a second diskette contains the INDEX disk utilities. The INDEX software and a user's manual (no source text this time) cost $100.

INDEX requires 8K of memory at addresses A000 through BFFF; thus the entire lower 32K of memory addresses is available for user programs (except for 0000-001F). Whereas SWTP's FLEX and SSB's DOS-68 are somewhat similar to each other, INDEX is again quite a departure. Just about the only similarity is that it uses dynamic allocation of disk space, like the others.

First of all, INDEX uses the interrupt system of the computer. The console terminal and other I/O devices are handled via interrupts, rather than constantly being polled as in the others. Both the terminal keyboard and the printer or display use a software buffer, so that I/O can be overlapped with computation. This can be timesaving, since input, computation and output can go on at the same time.

A second departure is that I/O equipment is treated the same as disk files, that is, a program having some output calls INDEX, gives it the name of a destination for the output data and then passes it to INDEX. If the destination is a disk file, then INDEX will write it on disk; if the destination is an output device, then INDEX will send it to that device.

Since I/O and files are handled the same way, the COPY command can be used to copy files, send data from one I/O device to another or transfer data between disk and I/O. Thus a program could, without any changes, store all its output on disk, and the COPY command could later be used to get the output off the disk and print it. This also means that it is easy to add new I/O equipment at a later time. As soon as an INDEX-compatible I/O driver is written to go with it, the new I/O device becomes a part of INDEX and can become either a source or destination for data.

Like the other disk operating systems, INDEX maintains a disk directory. But this directory contains much more information than the others. Each file has a version number and a date and a protection flag, which is used by the software to avoid accidental erasure of files. The directory entries are classified into levels, and the user can specify which levels he wants listed when he asks for a directory printout. Thus it is possible to get a printout of only user programs, not system programs. The level number of a program is also used when a disk is being copied.

Since INDEX is interrupt-driven, it can respond to user commands even while a user program is executing. One of its interesting capabilities is that the user can command INDEX to stop outputting without actually stopping a user program running at the same time. Thus the program can continue running, but its terminal output can be turned on and off at will. When off, the program obviously runs much faster.

INDEX has the following commands:
BACKUP—create a backup copy of an entire disk (except certain kinds of temporary files).
CONVERT—convert hexadecimal files of the S113 . . . . Type into pure binary files to save

space and time.
COPY—transfer data from one file or I/O device to another.
COUNT—count the number of lines and characters in an ASCII file.
DATE—change the current date being used by INDEX.
DELETE—delete a file.
DIR—list the diskette directory.
DISKEDIT—examine or modify the contents of a specific disk sector.
DISKINIT—initialize the disk and its directory.
EXAMINE—examine an ASCII file to look for control characters.
FILL—specify the number of fill characters (nulls) sent to the terminal after a line feed or form feed.
HELP—get instructions for using a given command.
RENAME—rename a file or change its protection flag.
SAVE—save memory contents to a file (or I/O device).
SETSTART—set the starting address of a program file.
SETVER—change the version number of a file.
SYSDISK—specify which drive holds the system disk.
USERDISK—specify which drive holds the user disk.
TYPE—list file contents on the terminal.

INDEX is a full DOS, in the same ball park as FLEX or DOS-68, but since it is an extra cost option, it may never become as popular. We have found MINIDOS-PLUS to be quite adequate for most uses, though not up to FLEX or DOS-68 in versatility.

MINIDOS/PLUSX Programs

With the basic disk system or on a $15 user's group disk, Percom provides patches to other people's cassette software. Both source code and object code are provided. This includes:
SWTP 8K BASIC version 2.0 or 2.2—permits saving and loading programs on the disk with SAVE, LOAD and APPEND commands.
Computerware Software Services Super Cassette BASIC version 4.0—same functions as SWTP BASIC patch above.
TSC Text Editor—a patch to implement disk SAVE and READ commands.
TSC Assembler—a patch to permit assembling programs from disk and put the object code back on the disk.
SWTP Cores Assembler—a patch to permit saving and loading source programs on the disk.
SSB Source Code Generator—a patch to permit saving the generated source code on the disk so that it can be edited and reassembled.

The following programs are also provided, either as part of the system or on the same user's group disk:
HEXLDR—for loading S113 . . . . type disk files, produced by the assembler, into memory.
DSKMAP—for examining the header for any disk sector or listing the contents of the sector.
MEMTST—for doing a memory test.
PRINTOUT—for printing out ASCII files on a printer.

There are two other patches, which are supplied separately ($18 each for instructions and a diskette with both source and object codes):
The BASIC Bandaid—patches SWTP 8K cassette BASIC version 2.0, 2.2 or 2.3 to allow saving and loading programs on disk, chaining of programs and sequential or random disk files.
The TSC Touchup—patches the TSC Text Editor and Text Processor (cassette versions). The editor patch is most interesting, since the patched editor is even better than TSC's own FLEX-based editor. The patch improves the editing within a line, allowing the addition, substitution or removal of characters within a line, a process which is awkward in the original TSC editor. It allows a disk-to-disk editing of files too long to fit into memory at one time. The editor can also edit BASIC source programs or data files.

Finally, Percom has written a BASIC interpreter and an assembler of their own (unfortunately, supplied without a source listing):
Super BASIC ($50) is a 12K disk BASIC that supports both sequential and random files. It is quite a bit faster than the SWTP BASICs but retains their BCD arithmetic for maximum accuracy in dollars-and-cents calculations. It provides PRINT USING for formatting, a LINPUT instruction for inputting a complete line of text including commas, array subscripting starting at either 0 or 1, direct execution of any DOS command within a BASIC program and a number of other interesting features. For example, it is possible to PEEK and POKE data into disk file buffers. In this way, it is possible to compress disk files into less than half the space they would need if stored in ASCII.
The assembler ($30) is a disk-to-disk assembler similar in function to the TSC assembler patch above but allows specifying assembly options at time of assembly, rather than requiring them as OPT statements in the source text.

Percom also has several business-oriented packages, including "Finder," a general-purpose filing system ($100), a mailing list program ($100) and a general ledger system ($200). A complete checkbook-balancing program and BASIC utilities for renumbering programs, producing paginated source listings and driving the terminal via the interrupt system are available from Star-Kits, PO Box 209, Mt. Kisco, New York 10549.

Another company providing PerCom-compatible programs is Hemenway Associates, 151 Tremont Street, Boston MA 02111, which has a STRUBAL compiler ($250) for a structured BASIC-like language, a relocating marco-assembler ($80), a relocating loader ($50) and a text editor with editing macros ($40). Microware's A/BASIC is available in a Percom version for $65. Much of Ed Smith's Software is also available in versions to go with MINIDOS, MINIDOS-PLUSX or INDEX. This includes a relocating macro assembler, loader, disassembler, relocater and others.

Listing 1.

```
                       NAM  PERCOM-TSC EDITOR
                       OPT  NOT,NOG
                  * ********************
                  * * PERCOM TSC/EDIT  *
                  * *  FOR PLUSX V3.0  *
                  * ********************
                  *  LINKAGE POINTS INTO TSC EDITOR
                  *
0058              SPCPT1 EQU  $58  TEXT FILE TARGET- BEGIN SAVE
005A              SPCPT2 EQU  $5A  TEXT FILE TARGET- END SAVE
0441              ERROR  EQU  $0441    EDITOR ERROR PROMPT
E07E              PDATA  EQU  $E07E    MIKBUG STRING PRINT
                  *
                  *   LINKAGE POINTS INTO PERCOM MINIDOS-PLUSX
                  *
7080              LINBUF EQU  $7080   INPUT LINE BUFFER AREA
70A0              LINPTR EQU  $70A0   INPUT CHARACTER POINTER
C42D              XINPUT EQU  $C42D     INPUT CHARACTER ROUTINE
C4BD              XFIND  EQU  $C4BD    SEARCH DIRECTORY FOR NAME
70A8              XFILE  EQU  $70A8    ALLOCATION FIELD
70AD              XBEG   EQU  $70AD    DUMP START ADDRESS
70AF              XEND   EQU  $70AF     DUMP  END ADDRESS
70B1              XEXEC  EQU  $70B1    PROGRAM EXEC ADDRESS
C554              XSAVE  EQU  $C554    PLUSX SAVE ROUTINE
C01B              MLOAD  EQU  $C01B    DOS NORMAL LOAD ROUTINE
C01E              MERR   EQU  $C01E    PRINT DOS ERROR CODE
C363              CRLF   EQU  $C363    PRINT CR/LF
0016              MTW    EQU  $0016    DOS TARGET MEMORY ADDRESS
0014              MTA    EQU  $0014    DOS RETURNS NEXT MEMORY LOCATION
0001              MDISK  EQU  $0001    DOS TRACK/SECTOR REQUEST
                  *
                  *   SAVE TEXT FILE FROM MEMORY TO DISK
                  *
13D3                     ORG  $13D3
13D3 CE 14 0C            LDX  #ASK     PROMPT MSG
13D6 BD E0 7E            JSR  PDATA    PRINT IT
13D9 CE 70 80            LDX  #LINBUF  POINT TO OUR
13DC FF 70 A0            STX  LINPTR     LINE BUFFER
13DF BD C4 2D            JSR  XINPUT   GO INPUT FILE NAME
13E2 86 20               LDAA #$20     OVERLAY 'EOL'
13E4 A7 00               STAA 0,X       WITH A 'BLANK'
13E6 DE 58               LDX  SPCPT1   TEXT BEGINNING ADDRESS
13E8 FF 70 AD            STX  XBEG     STORE IN OUR AREA
13EB DE 5A               LDX  SPCPT2   TEXT ENDING ADDRESS + 1
13ED 09                  DEX            CHAR
```

Advanced MINIDOS-PLUSX Programming Example

For those interested in assembly-language programming, Listing 1 shows the patches to the TSC Editor to enable it to run under the MINIDOS-PLUSX DOS. As mentioned before, MINIDOS-PLUSX works in conjunction with MINIDOS. Although the basic I/O diskette drivers in MINIDOS have a jump table and specified entry points, the higher-level directory handler in PLUSX does not. Phil had to scan through the handler and piece together parts that could be used to provide the functions needed. (Thank heaven for the source code!)

```
13EE FF 70 AF         STX  XEND     STORE IN ENDING ADDRESS
13F1 CE 00 0E         LDX  #$000E   USE EXEC AS FILE TYPE
13F4 FF 70 B1         STX  XEXEC
13F7 CE 00 00         LDX  #$0000   INDICATE LAST FILE ??
13FA FF 70 A8         STX  XFILE    USED FOR ALLOCATION
13FD BD C5 54         JSR  XSAVE    *** USE PLUSX TO SAVE IT WITH A NAME ***
1400 25 01            BCS  ER1      IF ERROR, REPORT IT
1402 39               RTS
1403 BD C3 63   ER1   JSR  CRLF
1406 BD C0 1E         JSR  MERR     PRINT ERROR CODE
1409 7E 04 41         JMP  ERROR    GO BACK TO EDITOR

140C 0D         ASK   FCB  $D,$A,0,0,0,0
1412 46               FCC  'FILE ? '
141A 04               FCB  4
                *
                *  READ TEXT FILE FROM DISK
                *
142D                  ORG  $142D
142D CE 14 0C         LDX  #ASK     FILE MSG
1430 BD E0 7E         JSR  PDATA    GO PRINT IT
1433 01               NOP

1447                  ORG  $1447
1447 CE 70 80         LDX  #LINBUF  POINT TO OUR BUFFER
144A FF 70 A0         STX  LINPTR   STORE IT
144D BD C4 2D         JSR  XINPUT   GO GET FILE NAME
1450 BD C4 BD         JSR  XFIND    FIND IT IN DIRECTORY
1453 25 AE            BCS  ER1      MAY NOT FIND IT
1455 EE 00            LDX  0,X      IF FOUND, USE DISK ADDRSS
1457 DF 01            STX  MDISK    STORE IT IN DOS AREA
1459 DE 40            LDX  $40      PICK UP END OF TEXT POINTER
145B DF 16            STX  MTW      STORE IN TARGET AREA
145D BD C0 1B         JSR  MLOAD    ** USE DOS LOAD FUNCTION **
1460 25 A1            BCS  ER1      GO PRINT ERRORS
1462 DE 14            LDX  MTA      POINT TO NEW END OF TEXT

146D                  ORG  $146D
146D 01               NOP
146E 01               NOP
146F 01               NOP
1470 01               NOP
1471 01               NOP
                *
0272                  ORG  $0272
0272 04 41            FDB  ERROR          CHANGE GAP VECTOR- NOT USED
                *
                      END
     NO ERROR(S) DETECTED
```

The routine called XINPUT is used to accept data from the terminal and place it into a line buffer. The routine XSAVE is used to provide a linkage into the save function. The directory can be searched via a routine called XFIND. If an entry is located, its diskette address will be returned to the calling program. This diskette address is then used to inform the I/O loader where to access the file. The loader routine MLOAD will then load a file into memory and return the next memory location after the file.

The save function involves three sequences: prompt for a file name, load parameters indicating the memory region to be saved and then the disk save function. The read function involves four jobs: prompt for file name, search the directory for the name, inform the loader of the file address and load the file into memory.

Conclusions

Several factors must be weighed when considering a disk system for your SWTP computer: why you want the system and how it will be used. Some of the areas to consider are:

- ease of use
- software support
- interface to user software
- access speed
- memory requirements
- cost
- future expansion
- compatibility with other disk systems in your area
- the product's future

The final answer will be a compromise, but we hope that it will be right for you. Order a user's manual for each company and look through it. This will give you the opportunity to look at the fine points of each system before making a decision.

The Smoke Signal system was the first on the scene, but it lacks some of the finer points of a general-purpose DOS. Some of the user information is displayed in hex rather than decimal. Control of the terminal is somewhat lacking . . . or obsolete. The facilities of the monitor and file-management routines make it easy to interface to assembly-language user software. The access time is slow, but this is to be expected with dynamic allocation.

For the BASIC crowd, the SSB/Computerware BASIC works well, and the availability of Computerware's random BASIC is nice, too. All in all, a good DOS, but it needs polish to bring it up to current standards.

The FLEX system from SWTP and TSC may be the best overall DOS for the general user. Moreover, at $900 for a dual-drive disk system, including a versatile DOS and good BASIC, the SWTP disk is a clear winner in the price/value category. The other systems have certain features that FLEX does not, but the layout of FLEX seems better.

We did not like the hardware constraints from SWTP. We also weren't pleased because the bootstrap in SWTBUG didn't always work well and because we had to install a jumper on the motherboard. The disk bootstrap also clobbers memory locations 2400-2547, which destroys any programs already about that. Then there is the problem of what happens if you accidentally push the RESET switch with a disk in the drive but not running. On the SWTP system, you will probably clobber the disk.

FLEX is also quite slow. But a large part of the reason is that, after each write, FLEX does a read of the disk to make sure that it was written right. This is an important feature to anyone concerned about losing his data or programs.

The SWTP Disk BASIC version 3.0, which comes with the system, is also slow, even slower than SWTP cassette BASICs. The Computerware BASIC that comes with the SSB disk runs anywhere from 50 to 80 percent faster. (Percom also has a BASIC that runs about 50 percent faster, but in their case they charge extra for it, so that may be an unfair comparison.) SSB has a FORTRAN compiler, and TSC has a new BASIC, both of which should be faster still, but both of these are expensive options. Moreover, when you consider that editing, compiling and then executing the program require a lot of disk operations and DOS interaction, the total running time for a compiled program is often longer than using an interpreter. A compiler can often be justified only for longer programs that are compiled only once and then run many times. Besides, typical business and home programs are mostly slowed down by the I/O speed, and in that case a compiler would make little difference.

The group at TSC has thought out a user-oriented piece of software, which works well. There are some incompatibilities with the disk BASIC, and the assembler output is not a MIKBUG object file (for those who like to see their programs), but these are surmountable. The FLEX system will probably become the standard, if for no other reason than that it comes from SWTP and TSC.

Above all, the new FLEX system and the big push from TSC to come out with more software is a welcome sign. But it does raise that $900 price somewhat when you consider getting more TSC software.

The Percom system is quite different from the others. Its $600 price for a complete, wired, single-drive system puts it into a completely different ball park. Unfortunately, this price

is deceivingly low. It's almost a sure bet that, not too long into the future, many Percom owners will plunk down the extra $400 or so for a second drive. Add to this $40 for MINIDOS-PLUSX, and you're above the price of the SWTP disk, getting close to the price of the SSB, without having as good a DOS.

For assembly-language programmers, the Percom disk is difficult to tie into character-oriented software. The need to squeeze the DOS into 2708 EPROMs has resulted in a DOS not easily adapted to such use. On the other hand, having the DOS in ROM is a tremendous convenience, especially in single-drive systems. It is also much less subject to being clobbered by a wayward program, and then, in turn, clobbering the disk.

Since it supports random disk files, Percom's Super BASIC is better than SWTP Disk BASIC, which doesn't. It is also less expensive than Computerware's Random Disk BASIC. But if all you want are sequential files, then SWTP and SSB provide a sequential disk BASIC for free, while you have to pay for Percom's.

The same kind of reasoning applies to Percom's INDEX operating system. INDEX is potentially much more versatile than FLEX and DOS-68 (although the new FLEX versions may equal it). But this is again an unfair comparison, since FLEX and DOS-68 are included in the price of the system, while INDEX (and the new FLEX) are extra cost options.

Now for the big question: Which is best? Which one to get? We can't quite answer that question for you. (This is an area where the two of use don't quite see eye to eye. Phil has all three disk systems on his computer and feels that the Percom is just a glorified cassette replacement, not in the same class as the SWTP or SSB systems. He thinks the SSB has the best hardware design, while SWTP's FLEX has the best software. Pete, on the other hand, owns the Percom and uses the SWTP disk at work. He has become accustomed to the simplicity of the Percom approach and feels more comfortable with it.)

Some Fixes

Here are several simple fixes for users of the SWTP MF-68 disk.

The current MF-68 uses a DC-2 controller board, but you may still have the older DC-1 controller. SWTP issued an update for that board some time ago. Add a 100 pF capacitor from the WD1771 chip, pin 31, to the ground that runs from pin 8 of IC5 (74LS139).

SWTBUG has a disk bootstrap for the SWTP disk, but it has a slight problem: it does not provide enough time for the drive motor to come up to speed before trying to load from the disk. (This was apparently due to a change in the Shugart drive, after SWTBUG was written.) To give some extra time, type the D before closing the drive door. This will start the motor, and the boot will wait for the door to close before trying to load.

When you do a reset, the head on drive 0 loads (moves up against the disk) and then retracts to track 0 while still touching the disk. It is also touching the disk during idle periods. This is somewhat awkward and, among other things, increases the chance of clobbering the disk when you push reset or if you accidentally turn off the power with the disk still in the drive. A modification is to pull out the 7407 IC at the top of the controller board and bend out pin 6 so it doesn't make contact when you replace the IC in the socket. Now the head will only load on command, and the drive will not go to track zero on a reset.

A note on the FLEX P command, used to direct output from the following command to the printer: It does not save or restore the status of the pause option, which provides a pause when you fill up a screen on a CRT terminal. If you have a printer and use it, then going back to the CRT will cause you to run off the screen. We don't know of a patch for this right now, but perhaps TSC does. ■

✓ Reader Service—see page 227

Pay Up

For small businesses, this payroll program, with disk files, can fill a software vacuum.

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I purchased my microcomputer system complete with software for use in the prescription department of my pharmacy, but it did not include programs for business activities such as payroll. I knew that with proper programs the system could be useful, but I had no knowledge of BASIC programming other than a couple of games that I had typed into the Sol. Then I happened upon a back issue of *Kilobaud* (Nov. 1977), with Ron Harvey's "Payroll Program for Small Businessmen." Although the program was written for SWTP BASIC, I kept reading my basic manual and tinkered with the program until it would run in my Sol, producing hard copy from my printer.

In his article, Mr. Harvey promised that file-handling additions would be forthcoming, but as I learned to handle both random and serial files while writing other programs, I decided to try to write the disk file payroll program on my own. I realize that few businesses have the hardware unless they also have professional programming help, but I hope the program will be of interest to those considering adding a disk operating system (DOS) to their present microcomputers.

My equipment includes a Processor Technology Sol with 48K memory, a Helios DOS with four diskettes, a VDM and an Okidata 110 serial line printer. I felt it necessary to use random access files rather than serial files so that employee changes and corrections would not be a problem. This program is written in Processor Technology Extended Disk BASIC, and will also run in PT Double Precision BASIC. It occupies 3203 bytes in my memory upon entry.

The Program

The program through line 100 sets the file names. I used an assigned name for the employee file and names derived from the data string input in line 60 so that I would not have to remember from month to month what I had named them. The names for F2$ and F3$ could be input each month, but remember, F2$ is always the previous period's F3$.

The ERRSET statements in lines 160 and 220 keep the program running if no file exists for a new employee, or for the first payroll period in the year, when no F2$ really exists.

Variables are simplified by the use of disk files, since only one set of employee data must be in memory at any time. The program reads employee data from the disk at line 180, then reads the previous period's Y-T-D balances from a different disk file at line 250.

The operator is asked to input the number of hours worked and any wage changes (bonuses, commissions) before FICA and FIT deductions are figured in lines 380 through 620. My payroll is on a monthly basis, but tables for weekly, semimonthly, etc., periods can easily be substituted in lines 440 to 620. The operator is again asked for the amount of wage changes after FICA and FIT deductions (such as contributions, insurance premiums), then the totals are output to the printer in lines 660 to 820.

If the employee data is run correctly, the program will loop to line 130 to figure the next employee data, then loop to line 260 to run the same employee data again and rewrite the bad data in F3$ (lines 840 to 860) as

Program listing.

```
10 REM--PYWIDSK--PAYROLL W/ DISK RECORDS
20 PRINT "\K"
30 PRINT "PAYROLL PROGRAM WITH DISK RECORDS"
40 PRINT "WRITTEN BY BERNAY DUSEK "
50 PRINT "FOR     ----------- COMPANY"
60 INPUT "FOR PAY PERIOD ENDING- MMDDYY ",D$
70 DIM S1$(9),N$(25)
80 LET F1$="DPEMP79/1"
90 LET F2$="PD.DP"+STR(VAL(D$(1,2))-1)+"9/1"
100 LET F3$="PD.DP"+STR(VAL(D$(1,2)))+"9/1"
110 INPUT "DO YOU NEED TO ADD EMPLOYEES? 0=NO 1=YES ",A
120 IF A=1 THEN 1040
130 FILE #1;F1$,3,,60
135 FILL N$," "
140 LET R=R+1
150 SET XI=1
160 ERRSET 900
170 PRINT "\K"
180 READ #1,R;E1,S1$,M,D1,R1,N$: CLOSE #1
190 ERRCLR
200 IF EOF(1)=6 THEN 900
210 IF R<>E1 THEN 900
220 ERRSET 1220
230 FILE #2;F2$,3,,80
240 SET XI=2
250 READ #2,E1;E1,P,P6,S1,S6,I,I6,D3,D6: CLOSE #2
260 ERRCLR
270 PRINT " ? HOURS WORKED EMPLOYEE # ";E1: CURSOR 2,30: INPUT H
280 PRINT "EMPLOYEE # ";%D;E1;" WORKED ";H;" HOURS"
290 PRINT
300 PRINT " SS # IS ";S1$: IF M=0 THEN 330
310 PRINT "EMPLOYEE IS MARRIED WITH ";D1;" DEPENDENTS"
320 GOTO 340
330 PRINT "EMPLOYEE IS SINGLE DECLARING ";D1;" DEPENDENTS"
340 PRINT "ANY ADD'N OR DEDUCTS BEFORE WH & SS ? ": INPUT D2
350 REM"IF WEEKLY OT PAID BRANCH HERE"
360 LET P=D2+(H*R1): IF P6>22900.00 THEN 420
370 IF P6+P>22900.00 THEN 400
380 LET S1=INT(P*.0613*100+.5)/100
390 GOTO 430
400 LET S1=INT((22900-P6*.0613)+0.5)/100
410 GOTO 430
420 LET S1=0
430 IF M=1 THEN 540
440 LET G=P-(D1*83.33)
450 IF G>1875 THEN  LET I=(G-1875)*.39+447.40
460 IF G<=1875 THEN  LET I=(G-1433)*.34+297.12
470 IF G<=1433 THEN  LET I=(G-1183)*.30+222.12
480 IF G<1133 THEN  LET I=(G-850)*.26+135.54
490 IF G<850 THEN  LET I=(G-567)*.21+76.11
500 IF G<567 THEN  LET I=(G-275)*.18+23.55
510 IF G<275 THEN  LET I=(6-118)*.15
520 IF G<118 THEN  LET I=0: IF I=0 THEN  LET P8=P8+P
530 GOTO 630
```

well as reprint the correct hard copy. Looping continues until the employee file F1$ is exhausted of employees, when a jump to line 900 completes the printout with a summary of the total cost for the period.

Lines 1040 through 1200 are used for setting up the employee data file, adding employees or making corrections to employee data. If memory size were a problem, this part could make up a separate program with the addition of a line statement: DIM S1$(9).

Line 1220 is used only during the first payroll period of the year, or if a new employee has no Y-T-D balance in F2$.

If no printer is available, deletion of the line with SLPT statements will feed output to the VDM, although a "Pause" or "input 'continue'?" statement will be needed to hold output data on the screen while writing checks or reducing to hard copy.

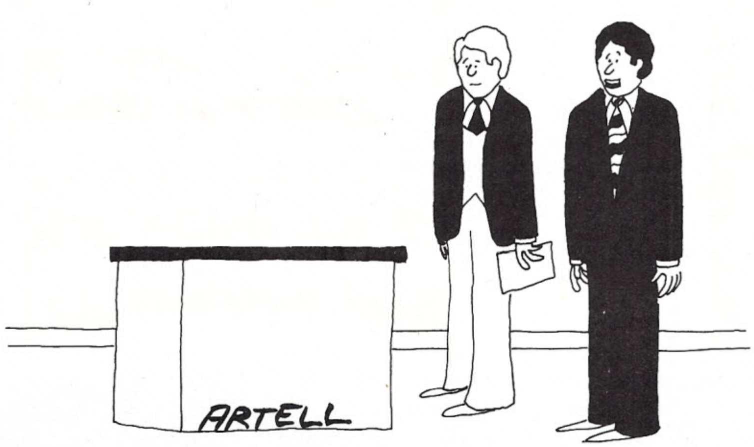
Before someone admonishes me about omitting overtime, I have considered that, and while the program for a weekly payroll period easily handles the situation as in Harvey's article, my solution for the monthly period has always been to simply adjust the "hours worked" entry. On any period other than weekly, unless separate entries were made for each week of the period, a specific entry would have to be made for the overtime hours.

I hope to finish my yearly payroll-related problems by writing a program to produce quarterly report and W-2 form data from the disk files, directly to the forms involved. ■

```
540 LET G=P-(D1*33.33)
550 IF G>2408 THEN  LET I=(G-2408)*.37+516.64
560 IF G<2408 THEN  LET I=(G-1967)*.32+375.52
570 IF G<1967 THEN  LET I=(G-1600)*.28+272.76
580 IF G<1600 THEN  LET I=(G-1250)*.24+188.76
590 IF G<1250 THEN  LET I=(G-908)*.21+116.94
600 IF G<908 THEN  LET I=(G-550)*.13+52.50
610 IF G<550 THEN  LET I=(G-200)*.15
620 IF G<200 THEN  LET I=0: IF I=0 THEN  LET P8=P8+P
630 LET P=INT(P*100+.5)/100: LET P3=P-S1-I: LET P6=P6+P
640 PRINT "ANY ADD'N OR DEDUCT AFTER WH & SS ": INPUT D3
650 LET P4=P3+D3: LET S6=S6+S1: LET I6=I6+I: LET D6=D6+D3
660 SET OF="SLPT"
670 PRINT "DUSEK PHARMACY-PAYROLL FOR MONTH END  ";D$: PRINT
671 PRINT "EMPLOYEE IS: ";N$
680 PRINT "EMPLOYEE NO ";E1;TAB(24);"NUMBER DEPEND   ";D1
690 IF M=0 THEN 710
700 PRINT "EMPLOYEE MARRIED ";TAB(24);"SS # IS ";S1$: GOTO 720
710 PRINT "EMP SINGLE     ";TAB(24);"SS # IS ";S1$
720 PRINT "HOURS WORKED  ";H;TAB(24);"RATE IS ";%$9F2;R1
730 PRINT %#$9F2
740 PRINT TAB(24);"MONTH";TAB(40);"YEAR TO DATE"
750 PRINT "GROSS PAY";TAB(24);P;TAB(44);P6
760 PRINT "FICA (SS)";TAB(24);S1;TAB(44);S6
770 PRINT "FED WH ";TAB(24);I;TAB(44);I6
780 PRINT "MISC + OR - ";TAB(24);D3;TAB(44);D6
790 PRINT TAB(22);"-----------            -------------"
800 PRINT "NET PAY ";TAB(24);P4;TAB(44);P6-S6-I6+D6
810 PRINT : PRINT : PRINT
820 SET OF=#0
830 PRINT %#
840 FILE #3;F3$,3,,80
850 SET XI=3
860 PRINT #3,E1;E1,P,P6,S1,S6,I,I6,D3,D6: CLOSE #3
870 INPUT "CORRECTION NEEDED ???? 1=YES",A: IF A=1 THEN 230
880 LET P9=P9+P3: LET S9=S9+S1: LET I9=I9+I: LET D9=D9+D3
890 GOTO 130
900 PRINT "PRINT PAYROLL SUMMARY NOW??(1=YES)": INPUT A
910 IF A=0 THEN 1240
920 SET OF="SLPT"
930 PRINT "PAYROLL SUMMARY FOR ";D$
940 PRINT %#$9F2
950 PRINT : PRINT "FICA EMPLOYEES";TAB(30);S9
960 PRINT "FICA EMPLOYER ";TAB(30);S9
970 PRINT "FED W H TAX ";TAB(30);I9
980 PRINT "MISC ADDN/DED";TAB(30);D9
990 PRINT : PRINT "NET PAY (INC MISC) ";TAB(30);P9
1000 PRINT "NON WH TAXED WAGES = ";TAB(30);P8
1010 PRINT "TOTAL PAYROLL COST";TAB(30);2*S9+I9+P9
1020 SET OF=#0
1030 GOTO 1240
1040 PRINT "TO CHANGE DATA ON EMPLOYEE MUST RE-INTER ALL"
1041 PRINT "OATA ON THAT EMPLOYEE."
1045 PAUSE 60
1050 FILE #1;F1$,3,,60
1060 PRINT "\K"
1065 CURSOR 1,0: PRINT "EMPLOYEE NAME "
1070 CURSOR 2,0: PRINT "EMPLOYEE # IS ----"
1080 CURSOR 3,0: PRINT "EMPLOYEE SOCIAL SEC # IS ---------"
1090 CURSOR 4,0: PRINT "EMPLOYEE IS MARRIED ??(0=NO,1=YES)"
1100 CURSOR 5,0: PRINT "EMPLOYEE HAS --- DEPENDENTS"
1110 CURSOR 6,0: PRINT "PAY RATE IS $ -----.--"
1115 CURSOR 1,14: INPUT N$
1120 CURSOR 2,13: INPUT E1
1130 CURSOR 3,24: INPUT S1$
1140 CURSOR 4,33: INPUT M
1150 CURSOR 5,12: INPUT D1
1160 CURSOR 6,13: INPUT R1
1170 PRINT #1,E1;E1,S1$,M,D1,R1,N$
1180 CLOSE #1
1190 PRINT "? ADD MORE EMPLOYEES ?(0=NO) ": INPUT A
1200 IF A=1 THEN 1050
1210 GOTO 130
1220 LET P=0: LET P6=0: LET S1=0: LET S6=0: LET I=0: LET I6=0: LET D3=0: LET D6
1230 GOTO 260
1240 END
SET OF=#0
```

```
                  LIST OF VARIABLES IN PROGRAM
A      INPUT FOR BRANCHING (0=NO,1=YES)
F1$    EMPLOYEE FILE                  F2$    PREV MONTH Y-T-D FILE
F3$    CURRENT MONTH Y-T-D FILE       D$     DATE
E1     EMPLOYEE NUMBER                R      FILE RECORD NUMBER
S1$    SOCIAL SECURITY NUMBER         M      MARITAL STATUS (1= MARRIED)
R1     PAY RATE                       P      GROSS PAY
P3     NET PAY                        P4     PAYCHECK AMOUNT
P6     GROSS PAY  Y-T-D               P8     WAGES NO WH TAX COVERED
S1     FICA DEDUCTED                  S6     FICA DEDUCTED Y-T-D
D1     # DEPENDENTS                   I      WH TAX AMNT
I6     WH TAX Y-T-D                   H      HOURS WORKED
D2     +/- BEFORE DEDUCTS             D3     +/- AFTER DEDUCTS
S9     TOTAL SS WITHHELD ALL EMPLOYEES
I9     TOTAL WH WITHHELD ALL EMPLOYEES
D9     TOTAL +/- AFTER DEDUCTS ALL EMPLOYEES
```

List of variables (D6 = ± after deducts Y-T-D).



"Once we figured out how to make the software transparent to the user, it was easy enough to make the hardware transparent too."

Discus I
Disk Jockey and ATE

Spinning the "platters" for you are our author and Thinker Toys.

Rod Hallen
Road Runner Ranch
PO Box 73
Tombstone AZ 85638

Why would anyone want to spend $1000, $2000 or more for a floppy-disk operating system when cassette-tape data storage is both inexpensive and reliable? Most personal computers include a cassette interface, and suitable cassette recorders can be purchased for less than $50. In addition, good quality tapes are less expensive than disks by a factor of 1 to 4. Why, then, did I decide, after using cassette-tape storage for more than a year and a half, to buy the Thinker Toys Discus I disk system and CP/M?

"Tape is too slow!" comes the immediate answer. But that is only a small part of the whole. "Convenience!" I cry, and we get closer to the truth. "Power!" my mind says as I consider what I can do now that was difficult, if not impossible, with tape. All of these answers sum up my reasoning. Did I get what I was looking for and am I satisfied with my choice? Follow my narrative and see for yourself.

Tape vs Disk

My major complaint with tape storage has always been the time required to store or load programs. Add to this that I always verify a program after it has been saved, and you're talking about a significant amount of time. My impatience is an important factor. In fact, I have just ordered a faster printer for this reason.

Consider my 15K BASIC interpreter. It loads from tape in three or four minutes but actually seems to take much longer than that. By contrast, I can load it from disk almost as fast as it takes for the cursor to move from the end of the command line back to the left-hand margin. Now that's quick!

Convenience means that the operating system takes care of most of the housekeeping chores without my intervention. Files are loaded from or stored on disk automatically as required. Programs can be configured as commands so that typing the program name loads and executes it. A directory and the status of each file on the disk is always available, as is the amount of remaining storage capacity.

What do I mean by power? An assembler, a text editor and debugger are instantly accessible. I can use them, do something else, use them again, etc. A complete system monitor is on-line at all times. I can dump, move or load specific memory locations; I can output to the screen or the printer or both at once; and I can still use cassette tape as backup if desired.

Have I started you thinking about how you interact with your tape storage and whether there might be a better way? Let's look at both the hardware and software components of the Discus I-ATE system and see what makes this such a useful and versatile programming tool.

Hardware

The Discus I hardware consists of a Shugart 800R full-size disk drive and the Disk Jockey I controller. Dual drives are available as an option. The drive is enclosed in an attractive blue cabinet, which also contains the power supply (see Photo 1). The controller is constructed on an S-100 8080-compatible circuit card (see Photo 2). The drive and the controller are interconnected with a 50-conductor ribbon cable. All hardware is factory assembled, tested and warranted to operate properly as a system. Kits are not available nor, in my opinion, are they desirable.

One unique feature of the controller is an on-board serial port. This port can be configured for either RS-232 or 20 mA operation, and the baud rate is software controllable. This has the advantage that you can use the entire system immediately without worrying about whether your resident I/O routines will match the Discus I software. It has the disadvantage that you have to write your own I/O routines first if you don't have a serial terminal.

The controller also incorporates ROM storage of a bootstrap loader. The ROM is normally addressed at E000 hex, and a simple EXecute E000 will load and execute the DOS (disk operating system). The system can be specially ordered with the ROM addressed at any 1K boundary.

Disk Jockey I will handle up to eight single-sided single-density 8-inch drives. It is also available without drives in case you already have one or more that you'd like to use. Any drive that is plug-compatible with the Shugart 800 will work. In fact, a switch-selected option allows the use of Shugart-400-compatible mini-drives instead of the 8-inch model if you desire. However, mini- and full-size drives cannot be intermixed on the same controller at the same time.

The controller supports the soft-sectored disk-storage format commonly known as IBM 3740. This makes it possible to interchange disks with many other systems that use the same format. This is also the format that CP/M is written in.

Since the receipt of this system almost three months ago, I have only had one hardware failure. After rearranging my computer room one day, I could not get the drive to run. Investigation quickly revealed that a wire which runs from the ac input connector to the back of the fuse holder had become loose at one end. It was supposed to be crimped to the fuse holder, but apparently the crimp was not tight enough. A pair of pliers solved that problem!

Software

Before we delve into the software that came with the system, I'd like to say a few words about documentation. I feel that, next to shoddy hardware, nothing will discourage a buyer quicker than poor documentation. I have owned, begged or borrowed a large amount of personal-computer equipment in the past two years, and I have always felt that

the level of hardware craftsmanship in the personal-computing field is universally high. The same cannot be said about some of the manuals, or so-called manuals, that I have seen.

While I had certain reservations about the Discus I paperwork at first, I have decided that I was trying to absorb too much, too quickly and just ended up confusing myself. When you consider that I was confronted with the Discus I manual (75 pages), the SA800 manual (50 pages), the ATE manual plus addendum (94 pages) and the CP/M manuals (six of them for 176 pages) and that I have had no previous disk experience, you will understand my confusion.

Unfortunately, I didn't recognize my problem at first. I wanted to understand everything all at once, which just wasn't possible. Looking back now, I would probably have learned more in an hour with someone by my side who knew ATE and CP/M than I did in the first few weeks on my own. However, it slowly but surely began to make sense. I've also found that rereading the books after working with the system for a while helps to clear up what at first appear to be difficult-to-understand explanations.

It took me a while to get the ATE manual straightened out. ATE was originally written as a cassette operating system and then upgraded to a disk system. The ATE manual still pertains to the cassette system with a 20-page addendum pointing out pertinent differences. I finally went through the manual with a red pen marking changes so that I had to make fewer references to the addendum.

Now let's look at the system software. Included in the Discus I price are a DOS called Disk/ATE (a monitor, assembler and text editor), CP/M patches in case you already own a CP/M master and an unusual BASIC interpreter called BASIC-V. The V stands for virtual and is indicative of this disk BASIC's use of any or all of the available disk storage for program operation. In practical terms, this means you can store and run BASIC programs whose size is limited only by the available disk storage capacity. How about a 250K byte Star-Trek program? BASIC-V is provided to all Discus I purchasers.

I bought one of the early models of Discus I and, as was to be expected, I found various errors and omissions in the manuals. I pointed these problems out to George Morrow of Thinker Toys, who assured me that all of them have been taken care of, so I won't bother to mention them. However, I did receive a CP/M master that was not write-protected. Just as cassettes can be write-protected by removing a small tab at the back of the cartridge, floppy disks can be protected by a notch at a given location on the disk jacket. Naturally, while experimenting with system operation, I promptly proceeded to erase my master. This required the return of the disk for rerecording.

ATE is a useful and effective disk operating system. Unless you have a special need for CP/M, ATE should fill all of your needs quite well. Without trying to dissect it thoroughly, I would like to present some of its features for your information.

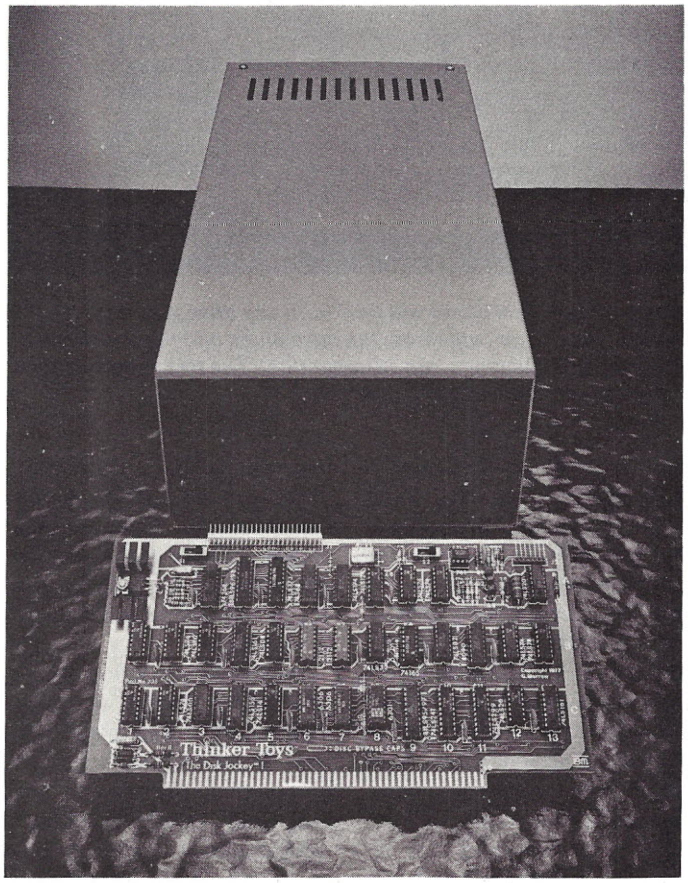


Photo 1. The Shugart 800R disk drive mounted in its attractive blue cabinet with power supply. Multiple drives are daisy-chained off of the first drive.

Disk/ATE is a system monitor, text editor, 8080 assembler and debugger. It supports file management and batch processing. General disk commands include: Save, Load, Identify, Free Space, Unsave, Transfer, Rename and many more. While most of these are self-explanatory, see Table 1 for clarification. When more than one drive is connected to the controller, the desired drive can be specified before a command is given.

The text editor can be used to edit written language such as English or French; it will also edit numbers, assembly language or anything else that can be represented with ASCII characters. Editing can be performed by line, character or string. A search feature will find and replace any or all appearances of a given string with one command.

You can even edit in a forward or reverse direction from a given point, depending upon the needs of the moment. Compiling macro-editing commands will reduce the typing required to handle frequently needed edit combinations. Since the edit commands are always available, they are used while creating programs with the assembler as well.

The assembler will handle source-program input in either the Intel or Processor Technology Software #1 format, which makes it compatible with a great deal of existing assembly-language software. No special spacing or line numbers are required. In fact, source listings can be entered as long continuous lines of labels, mnemonics and comments. The ATE assembler will format these automatically with a 50 percent savings in memory space as a bonus.

Input and output data can be in any number base above 5. This, of course, includes hex, octal and decimal. The assembler will also assemble programs that are larger than the RAM that is available, and it will combine any number of assembly-language routines by name into one integrated program. Anyone who has used a good assembler knows its true value. Add to this the speed and efficiency of disk storage and retrieval, and you have a valuable programming tool.

One last word about ATE before we move on: ATE is composed of a large number of subroutines designed to perform various functions. These include read and write to the disk and terminal, access to storage areas and evaluation of arguments. All of these subroutines are available to the assembly-language programmer by name. Custom commands that allow just about any type of file or data manipulation can be composed.

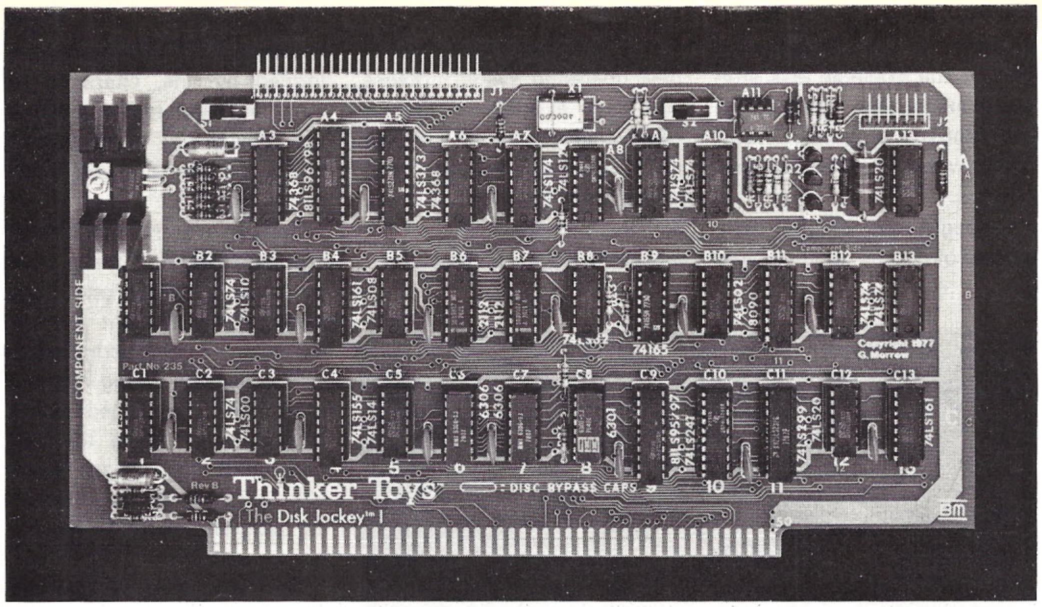


Photo 2. The Disk Jockey I disk controller board. This board will work with any drive that is plug compatible with the Shugart 400 or 800 series. The ribbon cable from the drive plugs into the connector at the upper left, and the cable from the serial terminal plugs into J2 upper right. The two slide switches, which select mini or maxi drive conditions, are above ICs A3 and A10.

CP/M is an extra-cost option, although it, along with Microsoft BASIC and FORTRAN, are available at the time of your Discus I purchase for a substantial discount. I bought CP/M for two reasons: because of the huge library of existing software written in that format and because I didn't know how really great Disk/ATE was. I haven't covered the features of CP/M here because that has already been taken care of quite well. See the list of the references at the end of this article for more information. Also worth investigating is the CP/M Users' Group, 164 West 83rd St., New York NY 10024, which has a large library of CP/M software available at nominal cost.

A final word on documentation. As I've said, you can't possibly hope to absorb all of the information that is provided with this system in a short period of time. I'm still learning three months later. Schematics for all hardware are given, options are explained and illustrated, and I have always been able to find an answer to each of my many questions if I looked long enough and hard enough.

Putting It All Together

Let's plug it in and make it go. In addition to the hardware problem mentioned earlier, I have had only one other major stumbling block: Discus I will not work with my TDL Z16 memory board although it works fine with Vandenberg, Seals and Processor Technology boards. The Z16 did not appear to be a new board when I received it from the factory, and I had to replace five ICs just to make it work. I have trouble with this board regularly, and since Xitan is not in a position to acknowledge my requests for assistance, I guess I'll have to retire it. I wouldn't have the nerve to sell it to anyone!

Assembling the system is a snap. The only kit-type work required is making up the plug that connects your terminal to the serial port. Then it is a matter of shutting off the computer, inserting the controller board, attaching the cables from the drive and the terminal and turning everything on.

One little snag quickly reared its head. As I mentioned earlier, the baud rate of the serial port is software-controlled and set in the PROM for 1200 baud. The only serial terminal that I have is a Teletype Model 43 KSR, which will run at 300 or 110 baud. Once the system has been bootstrapped (cold start), a baud-rate parameter is stored in a RAM scratchpad. By resetting the machine after the cold start, changing the baud-rate parameter and then restarting the system beyond the bootstrap (warm start), it is possible to use any terminal in the range of 110 to 4800 baud.

The baud-rate parameters are given in the manual, but information on how to initiate a warm start is harder to find. The following is the correct procedure: EXecute E000—RESET—ENter E270 87—EXecute 50C (all in hex). When you EXecute E000 your terminal will print garbage. When you EX 50C you will copy normally. The 87 entered at E270 is the 300 baud parameter.

Please note that the EXecuting and ENtering described above must take place from front-panel switches or from a keyboard that is interfaced to the computer and not from the terminal connected to the Disk Jockey I serial port. The software will not recognize the keyboard input to the serial port until the baud rate of the terminal and that of the Disk Jockey are the same.

This might require connecting the terminal first to its normal port and then to the disk controller port. In my case, I dedicated a switch on my computer control panel to switching the Model 43 between the SOL serial port and the Disk Jockey. None of this, of course, gives Discus I access to the video screen. Therefore, the first job that you will have for your new text editor and assembler will be to write I/O routines for your various peripherals. A great deal of information is given in the Discus I manual on how this is accomplished.

I have long since written the required I/O subroutines and now have complete use of two keyboards, a printer and the video screen. When I have a cassette tape to read or write (very seldom), I still do it manually, but this can be taken care of with software also, if desired.

I had some trouble initially in generating new CP/M diskettes until I discovered that the CP/M master contains a program called INTLIZE, which records sector addresses on a blank disk. After running this program,

S (filename)	Save a file on disk with the name given
L (filename)	Load the named file into RAM
GO (filename)	Load and execute named file
I	List directory
FS	List the number of free blocks and directory entries
U (filename)	Unsave (erase) the named file
T (oldfile)(newfile)	Transfer the contents of one file to another
TD (olddrive)(newdrive)	Transfer files from one drive to another
RN (oldname)(newname)	Rename a file
W (filename)(address)	Change a file load address
CD (newdrive)	Change the default drive (normally A)

Table 1. General disk commands.

I haven't had any further problems along this line. I have not been able to find INTLIZE mentioned anywhere in the CP/M manuals. As a no-cost option, my CP/M master came with BASIC-E recorded on it. This is a public-domain BASIC compiler that requires more than 20K to operate in. Due to the TDL Z16 failure, I don't have enough memory to run it yet, but I did buy a manual from Tarbell and it looks very interesting.

Personal Conclusions

I think that I have conveyed to you by now my satisfaction with my Discus I-ATE combination disk storage system. Although the advantages of the full-size disk over the mini have been covered elsewhere, let me recap them for you. The average 8-inch soft-sectored disk will store 250,000 bytes of information, and the average mini about 90,000. Thinker Toys claims that Discus I is also five times as fast as a mini.

One other factor to take into consideration is the operating-system storage space required. I place about 40K bytes of system software on each disk, which leaves me 200K for files. On a mini this 40K would amount to almost half of each disk. I haven't taken into account double-density recording and double-sided disks because they would still give the advantage to the full-size disk. Since an average mini-disk system costs about 2/3 of what the Discus I does, I'll let you formulate your own opinions on which is the better value.

For added convenience I plan to add a second drive soon. Then I can leave the system operating software in Drive A and swap files between drives. This also makes it much easier to create backup files, a procedure I strongly recommend.

One extremely important factor in customer satisfaction is factory or dealer response to problems. In this and previous dealings with George Morrow and Thinker Toys I have always come away with the feeling that they are very much concerned that you get your money's worth.

I'm glad that I decided on a disk system and I'm not sorry that I chose Discus I. The speed, convenience, power and price were all that I needed to convince me to buy. ■

References

"CP/M Primer," *Kilobaud*, April 1978, p. 30.

"The Electric Pencil for CP/M," *Interface Age,* August 1978, p. 148.

"Date and Time for CP/M," *Interface Age*, August 1978, p. 152.

"CP/M: an 8080 DOS," *Interface Age*, July 1978, p. 156.

Reader Service—see page 227

Expanded TRS-80 Disk Operations (Part 2)

More on storing machine-language programs and on backing up "uncopyable" programs.

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Part 1 of this article described a simple procedure for saving a machine-language program such as the Electric Pencil on a TRS-80 disk. The problem we sought to solve involved the overlapping memory requirements of both the Pencil and the TRS-80 disk operating system (DOS). Normally, the TRS-80 DOS will not reliably load a machine-language program into its own overlapping memory area, but we overcame this problem with a simple block-move routine that we attached permanently to the Pencil program.

After storing the Pencil with its attached block-move routine on disk, we then convinced DOS to load this modified Pencil program into an area of unused upper memory and to execute the block-move routine. The block move then moves Pencil to its normal memory location, thus overwriting DOS but with no undue consequences, and then performs a jump to Pencil's execution address. In this way, Pencil can be loaded from disk rather than from the much slower cassette.

It was also explained that the procedure could be generalized to virtually any other machine-language program. To prove this point, the following narrative will explain not only how to put Microchess 1.5 on disk, but it will also explain how to make a backup copy on cassette tape. This is no trivial task because, as most Microchess owners know, this program is well protected to prevent copying.

To repeat a moral imperative, the user is encouraged to make a backup copy of Microchess for his own use only and not to distribute free copies among friends. The instructions provided herein are intended for educational purposes only and not for pirating programs.

Putting Microchess 1.5 onto Disk

Microchess owners are by now aware that the program comes in two parts: a bootstrap loader and the main program. The loader is short and accomplishes essentially two things.

1. It takes over the chore of loading the main part of the program instead of letting TRS-80 ROM do the job.

2. After the main program (the second part) is loaded into the computer, the first part then puts the ASCII characters that make up the game's instructions onto the screen. The ASCII characters themselves are actually attached to the tail end of the main part of the program.

In order to see what, in fact, happens during the actual program-loading process, start by powering up the TRS-80 to initialize all memory locations. Because of memory requirements for our operation, it will be necessary to work initially in Level II BASIC rather than in Disk BASIC, so disable your disk when powering up. Microchess resides in lower RAM.

Proceed to load the first part of Microchess with the usual system command, file name and enter. When the loader is in and the recorder stops, do not load the second part . . . not yet, at least. We want to examine the loader machine-language instructions using RSM2 as we did in Part 1.

Get control of the TRS-80 by holding down the BREAK key and press the reset button. This procedure does not disturb the loader, which is residing somewhere in memory. Our first task will be to locate this loader in memory.

Next, load RSM2 as usual. The short bootstrap loader should still be intact in memory, and I happen to know from experience that loading RSM2 does not overwrite it. By searching through memory with the RSM2 ASCII or symbolic dump command (A or S, respectively), you should find the bootstrap loader starting at memory location 4FA1 hex. For the ASCII or symbolic dump procedures, refer either to the RSM2 documentation or part 1. The first instruction should appear in Zilog mnemonics as follows:

```
4FA1: 31 00 50    LD    SP,5000
```

The last Zilog instruction should read:

```
4FED: C3 FD 41    JP    41FD
```

This jump to 41FD is a jump to the Microchess execution address in the main program, and it is the last thing the loader does after it has served its purpose. After the jump, the loader is no longer used in the program. Write down the 41FD execution address for later use.

Before leaving the bootstrap loader, we need one more piece of information from it: Where in memory does it load the main part of the program? You will have to take my word for it without elaborate explanation that the loader instruction at memory location 4FB1 contains the answer. It reads:

```
4FB1: 21 C0 40    LD    HL,40C0
```

(It would be a good learning exercise for the interested reader to trace through the logic of the short bootstrap loader and to determine how the above command is interpreted as the start address of the main program.)

Write down the 40C0 start address—again for later use. This 40C0 address is where the first byte of the main program is loaded by the bootstrap loader. The start address is then incremented by the loader for each subsequent machine-language instruction until the entire program is loaded. We will verify this start address location for Microchess shortly by loading in the main program with the bootstrap loader and finding it in memory. Knowing in advance where to look obviously saves time.

We are finished now with this preliminary examination of the bootstrap loader, so the next step is to get back to Level II BASIC in order to get back to the main part of the program. Do this again by holding down the BREAK key while pressing the reset button. Now load Micro-

chess in the usual manner in its entirety, but stop when the game instructions are displayed on the screen—do not activate the game with the Enter key after the program is loaded.

With Microchess in memory, it is now necessary to get back to RSM2 without disturbing Microchess. The procedure is to again hold down the BREAK key while pressing Reset. Bypass the "Memory Size?" request and type System and Enter. Then perform a jump to the RSM2 execution address by typing the slash (/) and the execution address in decimal, which is 28308 for the 16K version (see your RSM2 documentation).

With RSM2 functional, you should be able to find the main program starting at 40C0. Don't bother looking for the end address just yet. The reason is that, although the ASCII instruction characters actually are contained in upper Microchess memory on the cassette tape, you won't find them stored in RAM because they were put on the screen by the bootstrap loader without being stored in memory. Furthermore, Microchess has modified itself in the loading process so that what you see in memory with RSM2 is not what is actually on the cassette tape from which Microchess was loaded. Consequently, we do not yet have all of Microchess in its originally programmed form available to us in memory for duplicating purposes.

Next, we must temporarily abandon the program as we just loaded it and load it again into another area of unused memory, using RSM2 this time so that it can be compared to what we loaded into memory location 40C0. This second load will allow us to examine the program as it is actually recorded on tape.

Set up the cassette recorder to read in the main part of the program again (bypassing the bootstrap loader), but to a different area in memory. We will load this main program with RSM2 into memory starting at 6504 hex rather than 6500 (which will be explained shortly).

We will be accomplishing two important things with this repeat loading process. First Microchess will be copied into memory by RSM2 with the original program and ASCII instruction characters intact. In other words, RSM2 will copy Microchess into 6504 memory exactly (almost) as it is recorded on tape. Second, we will discover a small quirk inherent in the RSM2 tape read program. So let's tell RSM2 to read the tape into memory starting at 6504 hex. The command is:

```
R 6504
```

Notice that the RSM2D R command is different from its R 0 command. We use the R command to read in Microchess because Microchess is not a system program. Again, refer to your RSM2D documentation for additional explanation of the R and R 0 commands.

After the main part of the program is fully loaded, it will be necessary to manually stop RSM2 from trying to read more data from tape by hitting the BREAK key. The reason for this is that although the bootstrap loader knows when to stop loading because of its own special coding, RSM2 does not know this esoteric termination code and so it keeps right on reading until it is told to stop or until it finds a familiar termination character. It will be up to you to determine when the program is fully loaded, either by audio means or by correlating in advance the tape counter indices with the program length.

Now for the RSM2 quirk. Using the symbolic dump command, notice the first four machine-language op codes for Microchess starting at memory location 40C0 (the real start address of Microchess as we initially loaded it with the bootstrap loader). You should see, sequentially, the hex bytes 90, 80, 20, 6E, 0A, 18, 00 and so on. At this point write down 90, 80, 20 and 6E. We will need them momentarily.

Next, perform the same symbolic dump starting at memory location 6504. Notice that starting at 6504 are the hex characters 0A, 18, 00, 15, etc. The first four hex bytes (90, 80, 20 and 6E) are missing! This is because RSM2 interprets these first four bytes as the start and end addresses of the program and does not put them into memory for us. It is necessary, therefore, to replace these first four hex bytes in the program, starting at 6500 hex.

Now you know why I had you load the program at 6504 instead of 6500 hex. It was necessary to leave room for the missing bytes, which we now have to replace. And you also know now why I hedged when I said that RSM2 loads the main program "almost" as it was originally recorded on tape.

The reason for this peculiarity in RSM2 operation can be explained quite simply. A typical system tape has at its beginning a sync byte, A5, for getting the tape going properly, followed by the file name and the start address for the program. The remainder of the system tape is program data. But Microchess is not a system tape. Since the bootstrap loader knows where to load the main part of the program, the start address does not precede the program data as in a typical system tape.

The RSM2 R command was designed to interpret the first two bytes of a non-system tape as the start address, and this it does even with Microchess. So RSM2 interprets the first two bytes, which are actually program data, as the start address. RSM2 uses these first two bytes for information only and does not store them in memory.

If you refer back to part 1 of this article, you will notice that nothing was lost when we followed a similar memory-loading procedure with the Electric Pencil, but in that process we used the R 0 command. The first two bytes after the file name in this case were properly interpreted by RSM2 as start-address information.

To replace the four missing bytes in the program, use the RSM2 Edit Memory command by typing in: E 6500 and Enter, followed by 90, 80, 20 and 6E, hitting the space bar after each byte. With these four bytes properly replaced in memory starting at 6500 hex, Microchess is now dormant here in its entire original form, except for its bootstrap loader, which we will not need.

Memory	Op Code	Mnemonic		Comments
77E5	F3	DI		;Disable Interrupt
77E6	210065	LD	HL,6500	;Source Address
77E9	11C040	LD	DE,40C0	;Destination Adrs
77EC	01E012	LD	BC,12E0	;Byte Count
77EF	EDB0	LDIR		;Move It!
77F1	21E173	LD	HL,73E1	;ASCII Pointer
77F4	11003C	LD	DE,3C00	;Screen Address
77F7	01FF03	LD	BC,03FF	;Byte Count
77FA	EDB0	LDIR		;Move It To Screen
77FC	C3FD41	JP	41FD	;Go To Execute

Table 1. Block-move instructions.

At this time you might want to view the ASCII characters residing in upper memory starting at 73E1, including the leading blanks. Note also that there is some ASCII text upward from 6500. If you look back at the original program at 40C0, you will notice that these ASCII characters are not there. This is part of the dynamic loading process employed by the program.

The upper-memory program as loaded by RSM2 should end at 77E0, including trailing blanks. Write down this end address.

Displaying the ASCII Instruction Characters

Since we will not depend on the bootstrap loader to display the ASCII instructions in our modified program, it will be necessary to devise our own means of accomplishing this. A block move will, again, serve our purpose.

But an additional block move is also required to get Micro-

chess to its proper memory at 40C0. Hence, we will have to put two block-move routines on the tail end of Microchess in upper, unused memory. Let's put these block-move routines at unused memory starting at 77E5 hex. The pair of block moves to get the job done is shown in Table 1.

By now it should not be necessary for me to provide a lengthy explanation of the block-move instructions. It should suffice to state that for each of the two moves, HL points to the source address, DE points to the destination address, BC provides a byte count and LDIR accomplishes the block move.

The first block-move routine, which starts at memory location 77E5, moves the program into position, and the second block-move routine, which starts at memory location 77F1, puts the ASCII instruction characters on the screen. The screen is memory mapped, and ASCII characters are displayed by loading them to memory locations 3C00 to 3FFF hex according to the appropriate location on the screen.

To attach the pair of block moves to Microchess with RSM2, use the Edit Memory command again. Type the command:

```
E 77E5
```

Then, continue by entering the machine-language op codes, starting with F3, 21, 00, 65, etc., pressing the space bar after each entry. When finished, get a symbolic dump with the RSM2 S command starting at 77E5. The Zilog mnemonics should read exactly as shown in Table 1, except for the comments. If they don't, correct your error(s) before proceeding.

Putting Microchess on Tape and Disk

Now for the moment we've been waiting for! Make a Chess system tape with RSM2 by typing:

```
P 6500 77FF 77E5
```

RSM2 will then ask for a name. Give it Chess, or whatever you prefer, but keep it down to six characters. Prepare the recorder before entering the file name. When the recorder stops, you will have a normal system tape that can be duplicated with available system duplicating programs. (If you don't have a machine-language system duplicating program, you can order one from me for $8.00, guaranteed to load and run.) Of course, you can make as many extra copies as you like with RSM2.

Before putting Chess onto disk, you can verify the accuracy of your work by telling RSM2 to "G 77E5" (Go to 77E5 and execute). The Chess game directions should appear on the display almost instantly. Pressing Enter again will activate the chessboard and game. If you do not get this result, hold down the BREAK key and press Reset. Then call up RSM2 again with a system command, followed by the slash and the RSM2 decimal execution address (61076). Find your error and make another Chess system tape before proceeding.

To put Chess on disk, bring up DOS and then call up the Tapedisk program. Load the Chess tape with the Tapedisk C command.

Prepare a disk and give the following instruction to Tapedisk:

```
F CHESS/CMD:0 6500 77FF 77E5
```

You can, of course, assign a different file name and/or disk drive if desired. And, as usual, 6500 is the start address, 77FF is the end address, and 77E5 is the execution address. That's all there is to it. You can now load Microchess 1.5 from disk rather than from cassette.

Although manipulating Microchess was a bit complex, it just goes to prove that a little time and patience can solve many complex problems. I feel a bit guilty about telling the world how to copy Microchess, but I also feel a responsibility to share knowledge with others. And with what you learned here, it should be possible to put your other prized machine-language programs on disk within the confines of available memory. You should also be able to make a backup copy of just about any machine-language program with what you learned here and a little thought. ■

✓ Reader Service—see page 227

The Best for Less

In conjunction with SSM, Jade offers a video board for under $120.

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One day, while flipping through my November 1977 issue of *Kilobaud*, I saw an advertisement for the Jade Video Interface . . . only $89.98. (As of December 1978, the price has gone up to $117.95.) The price intrigued me, so I quickly picked up the phone and dialed their toll-free number to find out how they could sell a video interface for such a low price. It turns out that Jade buys bare boards from a manufacturer (in this case, SSM—formerly Solid State Music) and sells them along with Jade's own parts as kits. This way you get almost the same product as you would get if you bought the manufacturer's kit, only it costs less. I immediately placed my order.

A few days later, my video kit arrived! Hurriedly I rushed into the house to examine my prize. After opening the box and inspecting the contents, I made arrangements with a friend to take pictures of the assembly and debugging process.

The kit was well packed in Styrofoam chips to prevent damage. Parts were packaged in small plastic bags, which, in turn, were packaged in a single large plastic bag. The memory chips, as well as the character generator chip, were inserted into black conductive foam to prevent static damage. All other ICs were inserted into Styrofoam. A quick check of the parts list proved everything was in order.

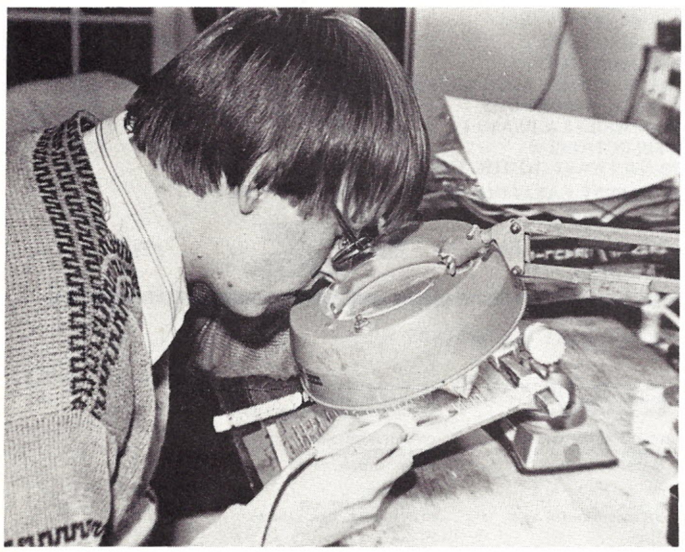

Photo 1. Assembly.

Assembly

Before pulling out my soldering iron, I cut a piece of Masonite to 6 by 10 inches—the exact size of an Altair-compatible board without counting the edge contacts. I then checked out the height of the IC sockets—the 16-pin sockets were the smallest, followed by the 14-pin and finally the 24-pin sockets. I mounted all of the 16-pin sockets on the PC board and placed the Masonite over the sockets. I then secured the PC board and the Masonite together with heavy rubber bands. This made a good tight fit and held the sockets securely.

Now I began the soldering process. I have found it best to assemble boards using a lighted magnifying glass as in Photo 1. This allows you to see your mistakes as you make them. Another advantage of using the lighted glass is that the flux smoke does not get into your eyes. With all of the sockets held in place it was a simple matter to solder all of the pins, row by row; it went very quickly. This process continued with the 14- and 24-pin sockets each in turn.

From there I followed the SSM instructions. Remember: If you put this kit together, do *not* mount the power resistors until after the voltages have been checked out. I had one bad 5 volt regulator that required replacing. Fortunately, I had one on hand; Jade sent a replacement at no cost.

The video connectors supplied by Jade must be cut to size in order to fit on the board. I bent mine at right angles to match the photograph of the completed board (on instruction sheet). This required trimming excess off the connector to allow the computer's cover to close. (The video connectors supplied with SSM kits are precut and sized to fit on the board without any modification.)

```
000 000 001 001 000   LOOP1  LXI B,1         set counter increment
000 003 041 000 374          LXI H,374000    starting address
000 006 333 377              IN 377          input sense switches
000 010 167           LOOP2  MOV M,A         move into display memory
000 011 011                  DAD B           add increment
000 012 332 000 000          JC LOOP1        if carry—start over
000 015 074                  INR A           increment character
000 016 303 010 000          JMP LOOP2       move next location
```

Table 1.

Testing and Debugging

Testing should be done on a proven video monitor; then after ascertaining that the board works, you might be able to use a converted black and white television. In my case, the only video monitor available was a 7-foot Advent television. A week later I acquired a Viatron monitor (a lot of these are showing up in the surplus market).

After hooking the monitor and computer together, I turned the computer on . . . it worked! A random sequence appeared on the screen. At this point all of the switches located in the upper right-hand corner of the board were in the off position. Counting across, 32 characters were present; counting down, there were 16 lines. Both were as they should be; everything was in order so far.

Turning the GRAH switch to the on position, I blanked out all of the black-on-white characters; it didn't look right but I continued my test. Turning the 64CL switch to the on position caused the display to jump to 64 characters per line.

Alright, what was wrong with the graphics? They are supposed to look different from each other. The assembly manual says the graphics are generated by the pair of 74150s. Looking over the board for solder bridges, I found the problem. Somehow, I missed two pins in my soldering—the 5 volt input pin on both 74150s. (I'm only a programmer, not an electronic wiz.)

After I soldered the two pins and plugged everything back together, everything worked.

I tested the character generator and memory with a simple test program (see Table 1). Set all switches to the off position (assuming there is no other memory at the top 1K of memory space). Load the program and start at location 000 000. The screen should look like Photo 3 with 32 characters per line, except with a lot of "snow." The computer and the display share the memory; only one can access the screen at any given time and the computer is the boss. As a result, the screen is blanked when the computer is using the memory. The test program accesses the memory as fast as possible. If you press STOP on the computer's front panel, the snow will go away.

To eliminate the annoying "snow," SSM has come out with a modification circuit. This modification (Fig. 1) requires three additional components and some wire and requires cutting traces on the PC board. I made the mod to my board using parts from my scrap box. Instead of having random black and white speckles, all speckles are black—that way you don't see them when displaying white characters on a black background. The mod really improves the picture, and I recommend it to all users.

Pushing the 64CL switch to the on position will increase the line to 64 characters, and the

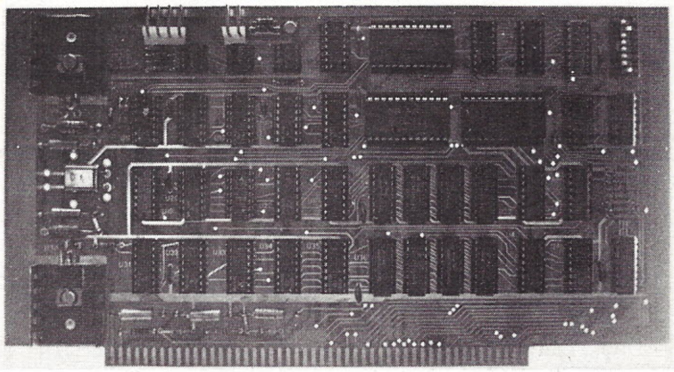

Photo 2. Completed video board.

If the user wishes to add additional screen blanking for the read and write access to the VB1B, some traces will have to be cut and added to the board. The periodic white and black dots generated during computer access will *all* become black with this modification of the VB1B.

Parts needed: 1—2.7k Ohm, 1/4 W resistor
1—0.0033 uF disk capacitor
1—1N270 germanium diode
1—wire, 26 to 30 gauge
1—sharp knife
1—14-pin socket (optional)
1—shrink tubing, 1/8 DIA.

Prodecure:

First the hard part—

1. Remove U13 from its socket.
2. Carefully pry up on the middle of each end of the socket of U13 and remove.
3. Slide out the plastic solder shield that is between the socket's pins.
4. Cut the trace between U13, pin 4 and U13, pin 10. Try not to damage (bend) the socket's pins.
5. Carefully put the plastic socket cover back on U13, or replace the socket pins with a new socket for U13.

Next cut—

6. Locate the socket for U8.
7. On the front side of the board, U8, pin 9 has one trace going to the right and down at an angle, which connects to U18, pin 8.
8. Cut this trace open somewhere along its length.
9. Cut the trace on the back between U13, pin 13 and U13, pin 10.
10. Cut the trace on the back between U13, pin 10 and U22, pin 15.

Now some jumpers (backside on board)—

11. Connect a jumper from U4, pin 11 to U10, pin 13. Input a hex inverter.
12. Connect a jumper from U13, pin 4 to U13, pin 13.
13. Connect a jumper from U13, pin 10 to U8, pin 9.
14. Connect a jumper from U13, pin 13 to U22, pin 15.

Add some parts (backside on board)—

15. You will have four connections made at U8, pin 9 after adding parts, so dress the parts connections carefully.
16. Connect a 2.7k Ohm resistor from U8, pin 16 to U8, pin 9. (See Ex. 1.)
17. Connect a 0.0033 uF capacitor from U8, pin 9 to U8, pin 8. (See Ex. 1.)
18. Connect a 6.75 inch wire to the anode (end without a band) lead of the diode. Add an insulating sleeve over the connection, if available. (See Ex. 2.)
19. (Connect the cathode (banded end) lead of the diode to U10, pin 12. (See Fig. 2.)
20. Connect the other end of the 6.75 inch wire to U8, pin 9.

Last—

21. Insert IC U13 back into its socket.

Fig. 1. Additional screen blanking for VB1B.

```
2900          ;NORTH STAR I/O ROUTINES
2900          ;
2900          ;
2900          ;
2900          ;IF VIDEO BOARD IS NOT AT F800-CHANGE THE
2900          ;EQUATES WHICH FOLLOW.INPUT ROUTINES WILL
2900          ;BE DIFFERENT FROM SYSTEM TO SYSTEM.
2900          ;
2900          TOP    EQU  0F800H  TOP OF SCREEN
2900          BOTTM  EQU  0FCH    BOTTOM OF SCREEN
2900          LINE   EQU  0FBH    1 LINE FROM BOTTOM
2900          ;
2900          ;JUMP TABLE
2900          ;
2900 C3 B3 29        JMP  CHIN    CHARACTER INPUT
2903 C3 C3 29        JMP  CHOUT   CHARACTER OUTPUT
2906 C3 DF 29        JMP  INIT    INITIALIZE I/O
2909 C3 E4 29        JMP  CCONT   CONTROL C CHECK
290C C3 61 29        JMP  CSEAR   CHARACTER SEARCH
290F 00 F8    PNTR   DW   TOP     CURSOR POINTER STORAGE
2911 00       FLIPF  DB   0       OUTPUT DEVICE SELECTOR
2912          ;
2912          ;VIDEO DRIVER
2912          ;CHARACTER IN B REGISTER
2912          ;
2912 E5       VIDEO  PUSH H       SAVE REGISTERS
2913 D5              PUSH D
2914 C5              PUSH B
2915 F5              PUSH PSW
2916 2A 0F 29        LHLD PNTR    GET CURSOR ADDRESSES
2919 7E              MOV  A,M     GET CHARACTER
291A E6 7F           ANI  7FH     STRIP OFF CURSOR
291C 77              MOV  M,A     PUT CHARACTER BACK
291D E5              PUSH H
```

Program listing.

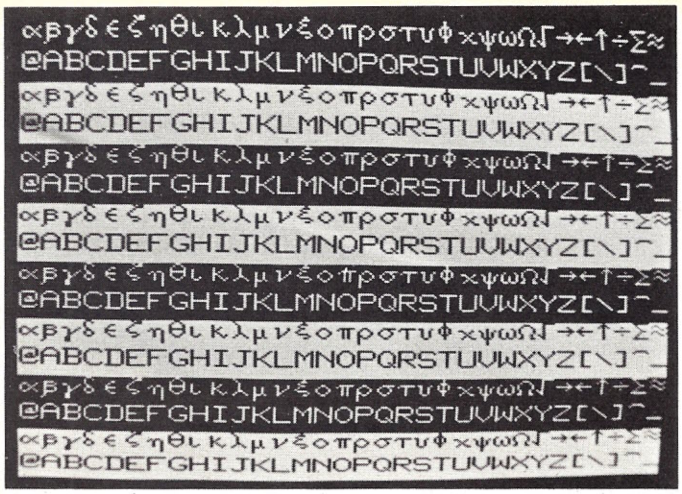

Photo 3. 32 characters per line.

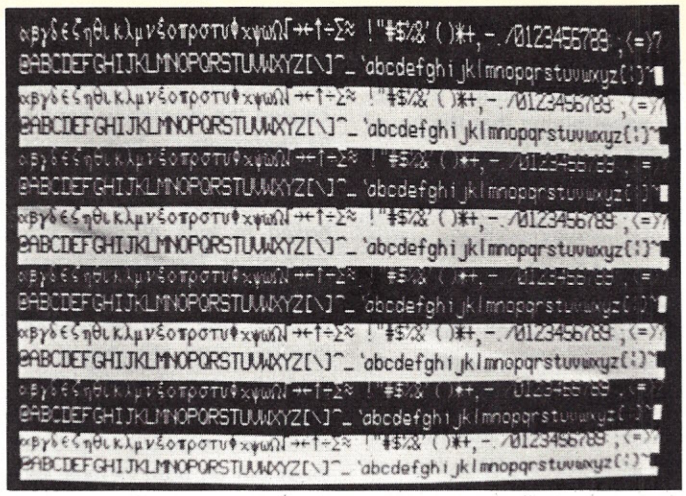

Photo 4. 64 characters per line.

display will be showing all of the ASCII characters in both the white-on-black and black-on-white formats (Photo 4). Every fourth line should be identical. If a difference is found, the difficulty probably can be traced to memory problems.

If you suspect a memory problem, try substituting the 2102s, one at a time, with "good" 2102s having the same or faster access time until the problem goes away. 2102s are common memory chips and are probably used on your memory boards. Be sure to take static precautions.

The speed of this display can be effectively shown by changing location 15 to 000, thus replacing the increment A (INRA) with a no-operation (NOP) instruction. Now, when the program is run, the character whose value is indicated in the switch register will fill the screen. With all of the switches down, 1024 αs will fill the screen (Photo 5). Set any of the switches to instantly fill the entire screen with the new character. This can be used to further isolate any problem you might suspect.

By flipping switch 15 up, graphics will be displayed. My favorite pattern (Photo 6) can be obtained by setting switches 15, 13, 11 and 8 up. I feel it can help you understand the graphics by experimenting with different switch settings.

I have talked to other people who have purchased this video board and discussed their problems. It turns out the most frequent problems are with the video monitor or, specifically, a converted television. In one case, a conversion circuit was

```
291E 11 E9 29         LXI   D,CTABLE     SET TABLE ADDRESS
2921 CD 61 29         CALL  CSEARC       SEARCH FOR COMMAND
2924 CA 28 29         JZ    CHAR         SEE IF IT IS A CHARACTER
2927 E9               PCHL               DO COMMAND
2928 E1         CHAR  POP   H            RESTORE CURSOR POINTER
2929 70               MOV   M,B          MOVE CHARACTER TO DISPLAY
292A 23               INX   H            INCREMENT CURSOR
292B 7C               MOV   A,H
292C FE FC            CPI   0FCH         BOTTM OF SCREEN?
292E CA 34 29         JZ    WHOLE        IF YES-SCROLL SCREEN UP
2931 C3 3D 29         JMP   VIDRET       TURN CURSOR BACK ON
2934 26 FB      WHOLE MVI   H,LINE
2936 7D               MOV   A,L
2937 F6 C0            ORI   0C0H         SET TO BEGINNING OF LINE
2939 6F               MOV   L,A
293A CD 4C 29         CALL  SCROLL       SCROLL PAGE
293D 7E         VIDRE MOV   A,M          GET CHARACTER
293E E6 7F            ANI   7FH          MAKE SURE CURSOR IS OFF
2940 C6 80            ADI   80H          TURN ON CURSOR
2942 77               MOV   M,A
2943 22 0F 29         SHLD  PNTR         SAVE CURSOR ADDRESS
2946 F1               POP   PSW          RESTORE REGISTERS
2947 C1               POP   B
2948 D1               POP   D
2949 E1               POP   H
294A 78               MOV   A,B
294B C9               RET
294C            ;
294C            ;SCROLL SCREEN SUBROUTINE
294C            ;
294C E5         SCROL PUSH  H            SAVE REGISTER FROM HARM
294D 11 00 F8         LXI   D,TOP        SET MOVE ADDRESSES
2950 21 40 F8         LXI   H,TOP+64
2953 7E         ROLL  MOV   A,M
2954 12               STAX  D
2955 36 20            MVI   M,' '        REPLACE WITH SPACE
2957 13               INX   D            INCREMENT TO NEXT  LOCATION
2958 23               INX   H
2959 7C               MOV   A,H
295A FE FC            CPI   BOTTM
295C C2 53 29         JNZ   ROLL         NO-ROLL AGAIN
295F E1               POP   H            YES-RESTORE REGISTERS
2960 C9               RET
2961            ;
2961            ;
2961            ;CHARACTER SEARCH ROUTINE
2961            ;TABLE IN DE-FUNCTION ADDRESS RETURNS IN HL IF MATCH
2961            ;
2961 1A         CSEAR LDAX  D            GET CHARACTER FROM TABLE
2962 B7               ORA   A            END OF TABLE?
2963 C8               RZ    YES-RETURN(A=0  INDICATING NO MATCH)
2964 B8               CMP   B            MATCH?
2965 13               INX   D
2966 CA 6E 29         JZ    CFOUND       YES-FOUND
2969 13               INX   D            NO-BYPASS AND LOOK AGAIN
296A 13               INX   D
296B C3 61 29         JMP   CSEARC
296E 1A         CFOUN LDAX  D            GET FUNCTION ADDRESS
296F 6F               MOV   L,A
2970 13               INX   D
2971 1A               LDAX  D
2972 67               MOV   H,A
2973 C6 07            ADI   A,1          SET MATCH FOUND INDICATOR
2975 C9               RET
2976            ;
2976            ;FORM FEED FUNCTION
2976            ;
2976 E1         CLEAR POP   H            CLEAR ENTIRE SCREEN
2977 21 00 F8         LXI   H,TOP
297A 36 20      CLR1  MVI   M,' '
297C 23               INX   H
297D 7C               MOV   A,H
297E FE FC            CPI   BOTTM        BOTTOM OF SCREEN?
2980 DA 7A 29         JC    CLR1         NO-KEEP CLEARING
2983 21 00 F8   HOME  LXI   H,TOP        SET CURSOR TO HOME
2986 C3 3D 29         JMP   VIDRET
2989            ;
2989            ;CARRIAGE RETURN FUNCTION
2989            ;
2989 E1         CR    POP   H            MOVE CURSOR
298A 7D               MOV   A,L         TO BEGINNING OF THE LINE
298B E6 C0            ANI   0C0H
298D 6F               MOV   L,A
298E C3 3D 29         JMP   VIDRET
2991            ;
2991            ;LINEFEED FUNCTION
```

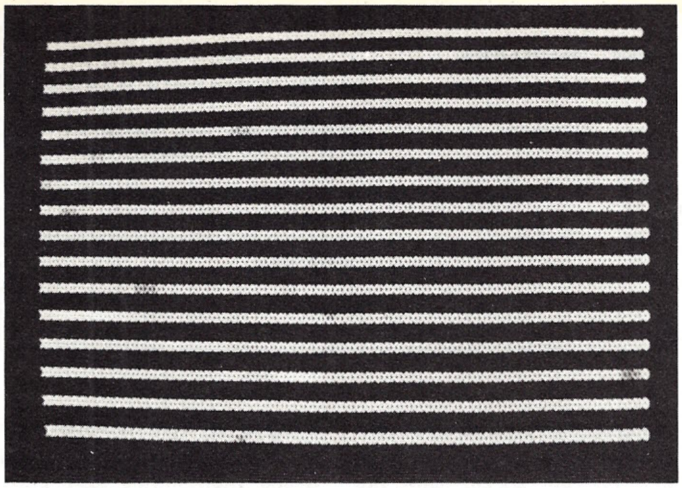

Photo 5. 1024 little fish.

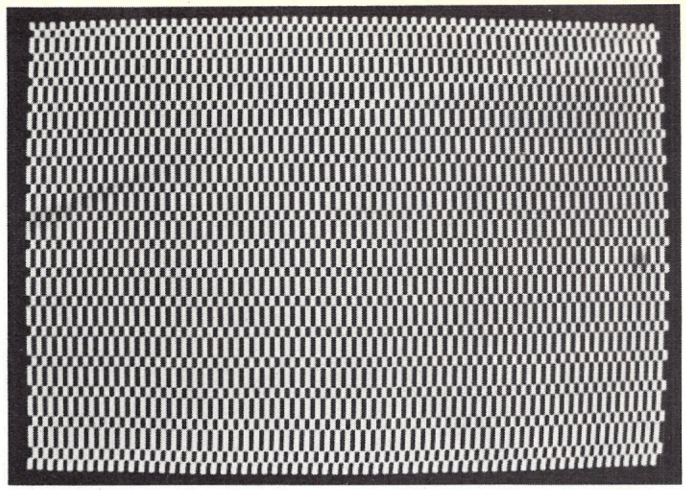

Photo 6. Checkers, anyone?

built from an article appearing in *Kilobaud* ("The Great TV to CRT Monitor Conversion," July 1977, page 30) and another from a computer club newsletter. Both had the same results: a clear picture that drifted everywhere.

A check with an oscilloscope showed that the sync pulse was being clipped by the conversion circuit. Thanks to a friend knowledgeable in electronics, the cause of this problem was found: The input resistor of the conversion circuit and the output resistor of the video board were incompatible. A simple change in the input resistor restored the sync and stabilized the picture. In another case, the problem was solved with a commercial (Pickles and Trout) conversion circuit.

The other problems that people had with their boards turned out to be solder bridges and bent IC pins that they managed to track down systematically. I have yet to hear of any major or unsolvable problems.

Operation

After my video board was working, I began to utilize it. I wrote my own video driver routine, with expansion capabilities, as the output device for a North Star Micro Disk System. The original routine, along with a keyboard, was hand assembled to fit in the 256 bytes allocated for I/O routines in North Star DOS. Once the routine had been toggled in and debugged through my front panel, I used an assembler to improve it. As I expected, I found it necessary to add additional features for different projects. The program listing shows the most universal version, along with my other I/O routines.

```
2991                 ;
2991 E1              LF      POP   H         MOVE AHEAD 64 LOCATIONS
2992 01 40 00                LXI   B,64     AND CLEAR LINE
2995 09                      DAD   B
2996 7C                      MOV   A,H
2997 FE FC                   CPI   BOTTM     BOTTOM OF SCREEN?
2999 CA 34 29                JZ    WHOLE     IF SO-SCROLL UP SCREEN
299C E5                      PUSH  H
299D 7D                      MOV   A,L       CLEAR LINE TO SPACES
299E E6 C0                   ANI   0C0H
29A0 6F                      MOV   L,A
29A1 36 20           FLOOP   MVI   M,'       MOVE SPACE INTO DISPLAY
29A3 23                      INX   H
29A4 0D                      DCR   C
29A5 C2 A1 29                JNZ   FLOOP     FINISHED?NO LOOP AGAIN
29A8 E1                      POP   H         RESTORE POINTER
29A9 C3 3D 29                JMP   VIDRET    TURN CURSOR BACK ON
29AC                 ;
29AC                 ;BACK SPACE FUNCTION
29AC                 ;
29AC E1              BACK    POP   H
29AD 2B                      DCX   H         BACK 1 POSITION
29AE 36 20                   MVI   M,' '     REPLACE WITH SPACE
29B0 C3 3D 29                JMP   VIDRET    TURN CURSOR BACK ON
29B3                 ;
29B3                 ;CHARACTER INPUT ROUTINE
29B3                 ;
29B3 DB 00           CHIN    IN    0
29B5 A7                      ANA   A
29B6 CA B3 29                JZ    CHIN
29B9 DB 00                   IN    0         GET DATA
29BB E6 7F                   ANI   7FH       MASK DOWN TO 7 BITS
29BD FE 7F                   CPI   7FH       RUBOUT?
29BF C0                      RNZ             RETURN IF NOT
29C0 3E 5F                   MVI   A,5FH     CONVERT TO RUB
29C2 C9                      RET
29C3                 ;
29C3                 ;CHARACTER OUTPUT ROUTINE
29C3                 ;
29C3 CD 12 29        CHOUT   CALL  VIDEO
29C6 3A 11 29                LDA   FLIPF
29C9 A7                      ANA   A         FLAG SET?
29CA CA D7 29                JZ    CLOOP     IF NOT BYPASS TTY
29CD DB 04           TTY     IN    4         INPUT STATUS
29CF E6 80                   ANI   80H       READY?
29D1 CA CD 29                JZ    TTY       IF NOT - LOOP
29D4 78                      MOV   A,B       YES - GET READY
29D5 D3 05                   OUT   5         OUTPUT TO TTY
29D7 DB 00           CLOOP   IN    0         HAS KEY BEEN RELEASED
29D9 A7                      ANA   A
29DA 78                      MOV   A,B       MAKE A AND THE SAME
29DB C8                      RZ              RETURN WHEN IT HAS
29DC C3 D7 29                JMP   CLOOP
29DF                 ;
29DF                 ;INITIALIZE ROUTINE
29DF                 ;
29DF 06 0C           INIT    MVI   B,12      CLEAR SCREEN
29E1 C3 12 29                JMP   VIDEO     THEN RETURN AS REQUESTED
29E4                 ;
29E4                 ;CHECK FOR CONTROL C ROUTINE
29E4                 ;
29E4 DB 00           CCONT   IN    0
29E6 FE 03                   CPI   3         SET Z IF CONTROL C
29E8 C9                      RET
29E9                 ;
29E9                 ;CHARACTER/FUNCTION TABLE
29E9                 ;
29E9 0D              CTABL   DB    13        CR
29EA 89 29                   DW    CR
29EC 0A                      DB    10        LF
29ED 91 29                   DW    LF
29EF 08                      DB    08        BS
29F0 AC 29                   DW    BACK
29F2 0C                      DB    12        FF
29F3 76 29                   DW    CLEAR
29F5 00                      DB    0

SYMBOL TABLE

BACK  29AC    BOTTM 00FC    CCONT 29E4    CFOUN 296E    CHAR  2928
CHIN  29B3    CHOUT 29C3    CLEAR 2976    CLOOP 29D7    CLR1  297A
CR    2989    CSEAR 2961    CTABL 29E9    FLIPF 2911    FLOOP 29A1
HOME  2983    INIT  29DF    LF    2991    LINE  00FB    PNTR  290F
ROLL  2953    SCROL 294C    TOP   F800    TTY   29CD    VIDEO 2912
VIDRE 293D    WHOLE 2934
```

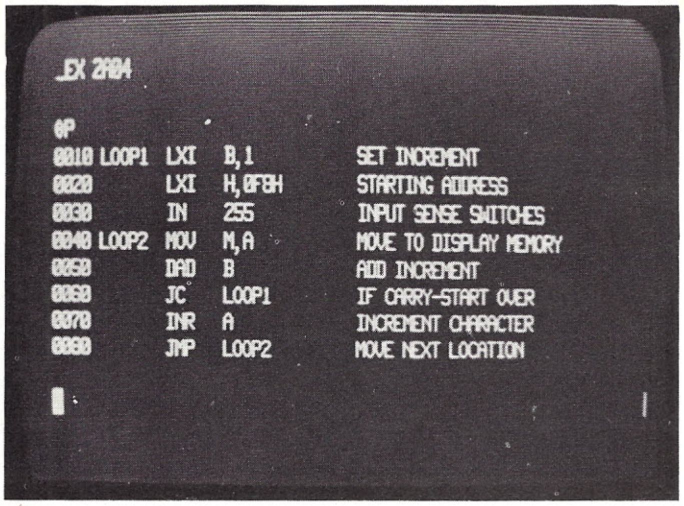

Photo 7. Driver routine in action.

ASCII	Function Name	Actual Task
CR	Carriage Return	Sets cursor to the beginning of the present line.
LF	Line feed	Increment to next line, fills the line with spaces. If at bottom of screen, a scroll is performed.
FF	Form feed (clear screen)	Fills entire screen with spaces, sets cursor to first location on screen.
BS	Back space	Moves cursor back one position and replaces it with a space.

Table 2.

Here is how the driver routine works: A call is made to the video routine with the character to be displayed in register #B; the registers that would be destroyed by the routine are then saved on the stack. The cursor pointer is retrieved and the cursor is turned off. (The cursor is visually indicated by a black character on a white background. This is obtained by setting bit 7 high in the display memory location desired.)

A comparison is then made to a table of special function characters. If a match is found, a jump is made to the appropriate function routine. The special functions that I include are shown in Table 2.

Additional functions can be added by entering them in the table and creating an appropriate subroutine. Be sure that a POP H is done first to restore the cursor pointer into the HL register pair and to keep the stack orderly. After performing the desired function, a jump should be made to VIDRET.

If the character in register B is not on the table, it will be placed into the display memory, and hence displayed. The cursor is then incremented to the next position on the display. When one line fills, the line will continue on the next line. Should the bottom line fill, a scroll of the entire screen will be made to provide room. Control then passes to VIDRET.

VIDRET will turn the cursor back on and restore the registers. The A register is required by North Star to contain the output character upon return. This is where that requirement is fulfilled.

Other features of my I/O routines include a clear screen on system start-up and the ability to "hold" a display. The clear screen is done by outputting a form-feed character in the initialize routine.

My keyboard is peculiar in that it has no strobe; when the data is there it is valid. Because of this the software must wait for a key to be released before accepting a new one. I do this in my output routine; thus, pressing a key (at any time the computer is outputting) will "hold" all further output. This is useful for listings and memory dumps.

I can also use a Teletype as an output device by changing the location FLIPF to a nonzero number. I can access this location through BASIC with the FILL command.

The concept of using a memory-mapped video board as an output device has been successfully employed by Processor Technology in their Sol and by PolyMorphic in their Poly 88 . . . my route just costs less. I have several plans for software-using video boards after everything is working; these plans range from a software front panel (monitor) to a text editor.

Summary

The Jade video interface has gone up to $117.95 since I got mine, but the price is still good. The SSM kit is available for $139.95 at local computer stores or directly from SSM.

My problems were limited to a bad 7805 voltage regulator and the two pins that I did not originally solder. Both problems were easily fixed. Other people had problems with either solder bridges or their monitor. The board went together quickly and easily. Instructions were sufficient for proper assembly.

The bare board, VB1B, manufactured by SSM, is excellent. The quality is in line with other SSM products I have seen or used. I am sure that I would have bought the SSM kit if I had not found out about the low mail-order price for the Jade kit.

The Jade parts were very good with the exception of the 7805 and the video connectors. It sure saves time letting someone else collect the parts to populate a bare board instead of ordering from a half-dozen mail-order houses. Jade is performing a great service to the computer hobbyist by creating these "kits." The people at Jade are courteous and will normally answer any questions about their products. ■

I would like to thank Stephan Zelenko for his photographic work.

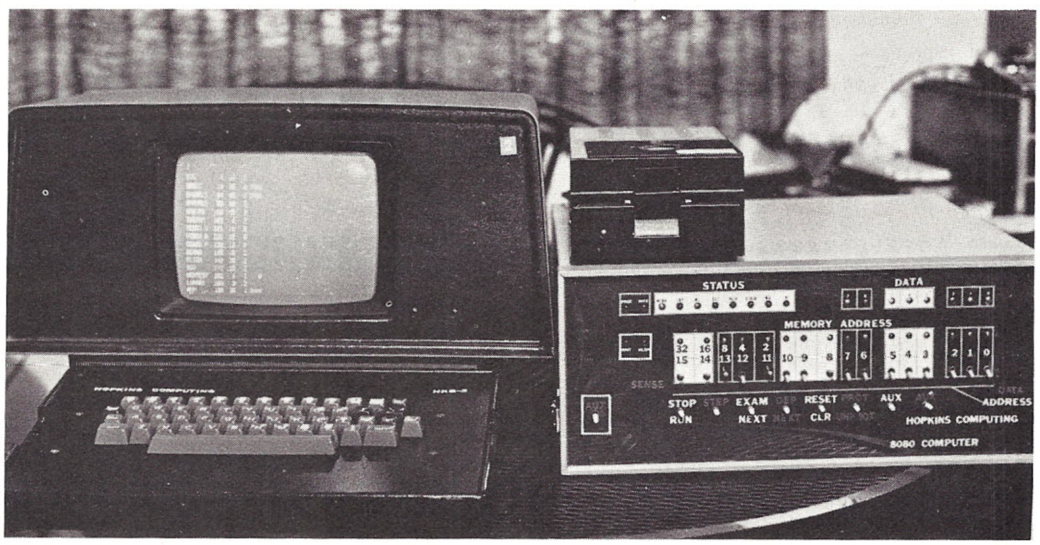

Photo 8. My complete system (today).

Wave the Flag

```
10 REM *** Draws a picture of the United States flag.
12 REM *** Written by David Larry Johnson for a PolyMorphic
14 REM *** POLY-88.  December
20 PRINT CHR$(12),
40 PRINT TAB(7),"U N I T E D   S T A T E S   O F   A M E R I C A"
60 FOR X=0 TO 127
80    FOR J=0 TO 2
100      Y=J+3
120      PLOT X,2,1
140      PLOT X,Y+3,1
160      PLOT X,Y+9,1
180      PLOT X,Y+15,1
200      IF X<=63 THEN 280
220      PLOT X,Y+21,1
240      PLOT X,Y+27,1
260      PLOT X,Y+33,1
280      PLOT X,42,1
300   NEXT J
320 NEXT X
340 FOR Y=3 TO 42
360   PLOT 0,Y,1
380   PLOT 1,Y,1
400   PLOT 127,Y,1
420   PLOT 126,Y,1
440 NEXT Y
460 FOR X=6 TO 56 STEP 10
480   PLOT X,39,1
500   PLOT X,35,1
520   PLOT X,31,1
540   PLOT X,27,1
560   PLOT X,23,1
580   IF X>=50 THEN 700
600   X1=X+5
620   PLOT X1,37,1
640   PLOT X1,33,1
660   PLOT X1,29,1
680   PLOT X1,25,1
700 NEXT X
720 FOR Y=21 TO 41
740   PLOT 62,Y,1
760   PLOT 63,Y,1
780 NEXT Y
800 A=INP(1)
```

Program listing.

David L. Johnson
4106 Montreal Ave.
Prince George VA 23875

Be patriotic! When the Fourth of July arrives, be the first on your block to have a flag-waving computer. (The flag doesn't actually wave, unless you have an unstable video.) This program is written for a PolyMorphic POLY-88 computer. It takes less than 700 bytes of memory using POLY Version A00 BASIC.

The program makes extensive use of the POLY PLOT command, which allows you to selectively make either dark or light small rectangles on the video screen. If you have a memory-mapped video output board that allows graphics, but do not have a command like the PLOT command, then you could get the same effect by using the POKE command. But it would require a complete rewrite of the program.

Line 20 of the program clears the screen. Lines 60 through 320 draw all the horizontal white stripes in the flag and the top and bottom borders of the flag. Lines 340 through 440 draw the left and right vertical borders of the flag. Lines 460 through 700 draw the stars. And lines 720 through 780 draw the right vertical line at the end of the star field. Line 800 keeps the cursor from appearing anywhere on the screen until a key is pressed.

This program should suggest many interesting and amusing pictures that you can create quite easily using a memory-mapped video terminal. And you will find it is especially easy if you have a command like the POLY PLOT command at your disposal. ■

Teamwork!

When you add the Selectra-Print System 9710 to your computer or terminal, you've got the winning team working for you!

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Standard Features

- IBM standard warranty on Selectric II™ typewriter
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- Finest printed copy available
- ASCII typing element
- 130 characters per line at 10 per inch, or 155 characters at 12 per inch
- Full upper and lower case alphanumeric characters
- Switch-selectable rates to 9.6 kbaud (serial port only)
- Tab command
- Backspace
- Index
- Bell
- Computer cable set
- Parallel interface
- All necessary software in PROM
- Choice of IBM colors

Optional Features

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- Correction
- Noise reduction
- RS-232 serial interface
- Pin feed
- Tractor feed
- All available typing elements
- Annual IBM service contract for Selectric II™
- Annual MCD service contract for Selectra-Print

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Boy, Did I Make a Killing!

Should you buy real estate? This real-property profit guide could aid your decision.

Frank J. Derfler
PO Box 17283
Montgomery AL 36117

Real estate is the "in" medium for investment. The news is full of stories about huge increases in the cost of new homes and increases in the value of old ones. But like most news stories and investment advice, there may be another side of the issue that needs to be examined. Investing in real estate takes money . . . usually borrowed. Borrowing money can be expensive, and the taxes and upkeep involved in some properties can be costly too. Other investment vehicles may seem to pay less on the surface, but they may compare quite favorably when all factors are considered. Consideration of all of the factors is something a computer can do quite well.

This program allows a rational analysis of what is sometimes an irrational issue: the amount of money that was (or might be) made from property investments. As Gilbert and Sullivan said, "Things are seldom what they seem."

Tax Rate

The tax advantage of property ownership is highly praised. This advantage is real, but it does not come cheaply. A tax advantage is gained primarily only after paying some hefty interest as a rental for the money you are using. A portion of this interest is taken as a deduction from income.

One important question revolves around how large a portion of the interest is deductible for you. The IRS has already allotted a standard amount of deduction for each category of taxpayer. You should have a considerable amount to deduct before itemizing deductions and, in ef-

Program listing. Property Profit program.

```
2 REM     A REAL PROPERTY PROFIT GUIDE
4 REM     BY FRANK J. DERFLER JR.
5 REM     1979
10 PRINT CHR${12} | REM CLEARS SCREEN
20 PRINT "          BOY DID I MAKE A KILLING''"
30 PRINT| PRINT
40 PRINT "THIS PROGRAM WILL HELP YOU TO DETERMINE YOUR"
50 PRINT "ACTUAL PROFIT OR LOSS FROM THE SALE OF A HOUSE"
60 PRINT "OR PROPERTY.  IT WILL ASK YOU MANY DIFFERENT"
70 PRINT "QUESTIONS.  IN SOME CASES IT WILL HELP YOU TO"
80 PRINT "COMPUTE THE INFORMATION REQUESTED.  HOPE YOU"
90 PRINT "MADE A BUNDLE'"|GOSUB 1650
100 GOSUB 1660
110 PRINT "WHAT PRICE DID YOU SELL YOUR PROPERTY FOR?"
120 PRINT "{ENTER 0 FOR HELP}"| INPUT S
130 PRINT|PRINT "WHAT WAS THE AMOUNT OF THE ORIGINAL"
140 PRINT "MORTGAGE OR LOAN?"|INPUT L
150 PRINT|PRINT "HOW MANY YEARS WAS THE ORIGINAL MORTGAGE OR"
160 PRINT"LOAN FOR?"| INPUT Y3| IF S>0 THEN GOTO 240
170 GOSUB 1660|PRINT "            SELLING PRICE"
180 PRINT "THE SELLING PRICE DEPENDS UPON MANY FACTORS, "
190 PRINT "BUT IF YOU ARE PROJECTING INTO THE FUTURE,"
200 PRINT "YOU MUST ASSUME SOME ANNUAL APPRECIATION RATE."
210 PRINT"WHAT PERCENT PER YEAR WILL YOUR PROPERTY APPRECIATE?"
220 INPUT A
230 A=A/100
240 PRINT|PRINT "WHAT WAS YOUR DOWN PAYMENT?"
250 INPUT D
260 PRINT|PRINT "HOW MANY YEARS AND MONTHS DID YOU OWN? {Y,M}"
270 INPUT Y,M| Y={Y*12+M}/12 | IF S>0 THEN GOTO 290
280 S={{1+A}↑Y}*{L+D}
290 GOSUB 1660
300 PRINT" YOUR SELLING PRICE IS :",%$10F2,S
310 REM  %$10F2 SETS DOLLARS FORMAT
320 G=S-{L+D}
330 PRINT
340 PRINT" YOUR CAPITAL GAIN {ORIGINAL PRICE"
350 PRINT" MINUS SELLING PRICE} IS :",%$10F2,G
360 GOSUB 1650|GOSUB 1660
370 PRINT "NOW WE WILL DETERMINE WHAT IT COST TO OWN"
380 PRINT "THAT PROPERTY."| PRINT
390 PRINT "PROPERTY TAX:  EITHER PROVIDE A YEARLY AVERAGE"
400 PRINT "FROM YOUR RECORDS OR ESTIMATE YOUR YEARLY PAYMENT"
410 INPUT T2| PRINT
420 PRINT "WHAT IS THE INTEREST RATE ON YOUR MORTGAGE?"
430 INPUT I
440 I=I/12/100 |Y1=INT {Y*12}| L5=L
450 Q1=1/{1+I}↑{12*Y3}
460 Q2=L5*I/{1-Q1}
470 Q2=INT{Q2*100+.5} /100
480 FOR X5=1 TO Y1
490 U2=INT {L5*I*100+.5}/100
500 U3= Q2-U2
510 L5=L5- U3 | I6=I6+U2
520 NEXT | I9=I6/Y
530 PRINT" YOUR INTEREST PAID IS:",%$10F2,I6
540 GOSUB 1650|GOSUB 1660
550 PRINT "PLEASE SELECT YOUR APPROXIMATE ADJUSTED GROSS"
560 PRINT "INCOME FOR TAX PURPOSES FROM THE FOLLOWING:"
```

```
570 PRINT "      1. $5000 TO $10,000"
580 PRINT "      2. $10,000 TO $15,000"
590 PRINT "      3. $15,000 TO $20,000"
600 PRINT "      4. $20,000 TO $25,000"
610 PRINT "      5. $25,000 TO $30,000"
620 PRINT "      6. $30,000 TO $35,000"
630 PRINT "      7. $35,000 TO $40,000"
640 PRINT| PRINT "TYPE IN THE NUMBER OF THE BRACKET YOU ARE IN"
650 INPUT Z1
660 PRINT| PRINT "DO YOU FILE SINGLE {1} OR JOINTLY {2}?"
670 INPUT Z2 | IF Z2=2 THEN GOTO 760
680 ON Z1 GOTO 690,700,710,720,730,740,750
690 T1=.04 | T3=.23|GOTO 840
700 T1=.10 | T3=.28|GOTO 840
710 T1=.17 | T3=.33|GOTO 840
720 T1=.24 | T3=.39|GOTO 840
730 T1=.32 | T3=.42|GOTO 840
740 T1=.40 | T3=.46|GOTO 840
750 T1=.48 | T3=.49|GOTO 840
760 ON Z1 GOTO 770,780,790,800,810,820,830
770 T1=.05 | T3=.19|GOTO 840
780 T1=.08 | T3=.22|GOTO 840
790 T1=.11 | T3=.26|GOTO 840
800 T1=.15 | T3=.32|GOTO 840
810 T1=.20 | T3=.36|GOTO 840
820 T1=.25 | T3=.39|GOTO 840
830 T1=.30 | T3=.44|GOTO 840
840 PRINT| PRINT "DO YOU PAY STATE INCOME TAX?  {Y OR N}"
850 INPUT B$ |IF B$="Y" THEN T1=T1+{T1*.3}
860 C2={{1-T1}*I9}+{{1-T1}*T2}
870 GOSUB 1660
880 PRINT "DO YOU KNOW WHAT INSURANCE ON THIS PROPERTY "
890 PRINT "COSTS PER YEAR?  {Y= YES  N=NO}"
900 INPUT C$
910 IF C$="N" THEN GOTO 940
920 PRINT "INSURANCE COST PER YEAR?"
930 INPUT N| GOTO 960
940 N=S*.002
950 PRINT"AN ESTIMATE, BASED ON  SELLING PRICE IS:",%$10F2,N
960 PRINT|PRINT "CAN YOU PROVIDE AN ESTIMATE OF THE ANNUAL"
970 PRINT "AMOUNT SPENT ON UPKEEP OF THE PROPERTY?  {Y OR N}"
980 INPUT D$| IF D$="N" THEN GOTO 1010
990 PRINT "ANNUAL MAINTENANCE COST?"
1000 INPUT K | GOTO 1030
1010 K=S*.005
1020 PRINT"YEARLY ESTIMATE, BASED ON SELLING PRICE :",%$10F2,K
1030 PRINT|PRINT"CAN YOU ESTIMATE CLOSING COSTS?  {Y OR N}"
1040 INPUT D$| IF D$="N" THEN 1070
1050 PRINT"CLOSING COSTS?"
1060 INPUT C1| GOTO 1100
1070 C1=S*.01
1080 PRINT "ESTIMATE, BASED ON SELLING PRICE IS :",%$10F2,C1
1090 GOSUB 1650|GOSUB 1660
1100 PRINT|PRINT"DID YOU SELL THROUGH A REALTOR? {Y OR N}"
1110 INPUT G$ |IF G$="N" THEN GOTO 1180
1120 PRINT "DO YOU KNOW THE REALTORS PERCENTAGE?"
1130 INPUT E$|IF E$="N" THEN GOTO 1160
1140 PRINT "REALTOR'S PERCENTAGE?"
1150 INPUT F3|F=F3/100|GOSUB 1660|GOTO 1190
1160 F=.065|F1=S*F
1170 PRINT "ESTIMATE THE FEE WILL BE :",%$10F2,F1
1180 GOSUB 1650|GOSUB 1660
1190 PRINT"ENTER ANY OTHER COSTS SUCH AS POINTS TO SELLER"
1200 PRINT"FIX UP, LANDSCAPE, ADVERTISING ETC."|INPUT P
1210 C4={F*S}+P| C3=K+N
1220 E=Y*{C2+C3}+C1+C4 | Z=G-E
1230 GOSUB 1660
1240 PRINT| PRINT"      IT COST YOU",%$10F2,E
1250 PRINT"      TO OWN THAT PROPERTY."
1260 PRINT|PRINT"      BASED ON A SELLING PRICE OF :",%$10F2,S
1270 PRINT"      YOUR NET RETURN IS :",%$10F2,Z
1280 PRINT| PRINT "WOULD YOU LIKE TO COMPARE THIS TO THE"
1290 PRINT "ALTERNATIVE OF RENTING? "
1300 GOSUB 1650| GOSUB 1660
1310 PRINT"            COMPARISON TO RENTING "
1320 PRINT| PRINT "WHAT WOULD IT COST PER MONTH TO RENT OR"
1330 PRINT" LEASE A SIMILAR PROPERTY?"
1340 INPUT R1| M1= INT {E/Y1}| IF R1 M1 THEN GOTO 1380
1350 D6=R1-M1
1360 PRINT
1370 PRINT"YOU ARE ",%$10F2,D6," A MONTH AHEAD BY OWNING'"|END
1380 D1=M1-R1| PRINT "THAT FEE IS ",%$10F2,D1," LESS THAN"
1390 PRINT"YOUR AVERAGE MONTHLY COST OF OWNING."
1400 PRINT|PRINT"WHAT IS THE HIGHEST PER CENT OF RETURN"
1410 PRINT"YOU WOULD EXPECT FROM YOUR TYPICAL INVESTMENT"
1420 PRINT"{SAVINGS, DEPOSIT CERTIFICATE, BOND ETC.}?"
1430 INPUT R3
1440 R3=R3/Y1/100
1450 D3=D*{1+R3} {4*Y}| D3=INT{D3*100+.5}/100
1460 D4=D1*{{1+R3} {12*Y}-1}/R3| D4=INT{D4*100+.5}/100
1470 D5=D4+D3
1480 GOSUB 1660
1490 PRINT"AT THE INTEREST RATE YOU SPECIFIED, YOUR "
1500 PRINT"DOWNPAYMENT AND MONTHLY INVESTMENTS WOULD"
1510 PRINT"HAVE GROWN TO :",%$10F2,D5
1520 R7=R1*Y1
1530 PRINT|PRINT"YOUR COST FOR RENT WOULD HAVE BEEN:",%$10F2,R7
1540 GOSUB 1650| GOSUB 1660
1550 PRINT" OWNING AND SELLING BROUGHT YOU ",%$10F2,Z+D
1560 PRINT" CASH IN HAND."
1570 PRINT
1580 Z6=D5-R7
1590 F0=D4-{D1*Y1}|F1=D3-D|F2={F0+F1}-{{F0+F1}*{T3*Y}}
1600 F3=F0+F1+F2+D-R7
1610 PRINT" RENTING AND INVESTING BROUGHT YOU  :",%$10F2,Z6
1620 PRINT"OR {IF THE INTEREST WAS FULLY TAXED}:",%$10F2,F3
1630 PRINT" CASH IN HAND."
1640 END
1650 PRINT"PRESS RETURN TO CONTINUE"|INPUT A$|RETURN
1660PRINT CHR${12}|FOR Z3=1 TO 55| PRINT "$",|NEXT |PRINT|PRINT
1670 RETURN
READY
```

fect, saying "No thank you" to the standard deduction (over $3200 for married persons filing a joint return). A portion of the itemized deductions then goes only toward offsetting the standard deduction. In effect, you have to pull yourself over the standard deduction with some heavy spending before you get some benefit from your additional deductible expenses.

This ratio of deductions to tax avoided is the marginal tax benefit or marginal tax rate. It is quite different from the dollar-added tax rate, which is the ratio of dollar of income to dollar of tax paid. This dollar-added tax rate is higher and is what is normally meant by the description "tax bracket." Simply stated, the Fed giveth back more slowly than the Fed taketh away (that should come as no surprise).

It is important to an investor, then, to weigh all of the variables before making a commitment. Of course, some factors, such as the inbred desire to own property, cannot be easily quantified. The computer only aids in decision making, but it does it a lot better than a stubby pencil and green eyeshade.

The Program

This program was designed to be used by anyone owning or considering the purchase of property. It asks for many cost factors, but it is also capable of providing help or using built-in estimators to derive those factors if they are not known.

As an example, it asks for the actual yearly cost to insure a piece of property. If this cost is not immediately known, the program contains an estimator that will provide a ball-park figure based on the current selling price.

The program also contains tax tables with the values for the marginal benefit and dollar-added tax rates. I only provided the values for single taxpayers and married people filing joint returns. The other two tax categories are used far less frequently. If people in these categories tell the computer they are filing as single taxpayers, the results will not be too far off. If the values in the tax table (lines 690 to 830) seem to jump strangely, I can only attribute it to the nonlinearities in the federal tax structure caused by lumping adjusted gross income into brackets.

Sample run.

```
        BOY DID I MAKE A KILLING!!

THIS PROGRAM WILL HELP YOU TO DETERMINE YOUR
ACTUAL PROFIT OR LOSS FROM THE SALE OF A HOUSE
OR PROPERTY.  IT WILL ASK YOU MANY DIFFERENT
QUESTIONS.  IN SOME CASES IT WILL HELP YOU TO
COMPUTE THE INFORMATION REQUESTED.  HOPE YOU
MADE A BUNDLE!
PRESS RETURN TO CONTINUE
?

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

WHAT PRICE DID YOU SELL YOUR PROPERTY FOR?
(ENTER 0 FOR HELP)
?99500

WHAT WAS THE AMOUNT OF THE ORIGINAL
MORTGAGE OR LOAN?
?50000

HOW MANY YEARS WAS THE ORIGINAL MORTGAGE OR
LOAN FOR?
?29

WHAT WAS YOUR DOWN PAYMENT?
?20000

HOW MANY YEARS AND MONTHS DID YOU OWN? (Y,M)
?3,2

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

 YOUR SELLING PRICE IS : $99500.00

 YOUR CAPITAL GAIN (ORIGINAL PRICE
 MINUS SELLING PRICE) IS : $29500.00
PRESS RETURN TO CONTINUE
?

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
```

```
NOW WE WILL DETERMINE WHAT IT COST TO OWN
THAT PROPERTY.

PROPERTY TAX:  EITHER PROVIDE A YEARLY AVERAGE
FROM YOUR RECORDS OR ESTIMATE YOUR YEARLY PAYMENT
?600
WHAT IS THE INTEREST RATE ON YOUR MORTGAGE?
?8
 YOUR INTEREST PAID IS: $12480.37
PRESS RETURN TO CONTINUE
?

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

PLEASE SELECT YOUR APPROXIMATE ADJUSTED GROSS
INCOME FOR TAX PURPOSES FROM THE FOLLOWING:
     1. $5000 TO $10,000
     2. $10,000 TO $15,000
     3. $15,000 TO $20,000
     4. $20,000 TO $25,000
     5. $25,000 TO $30,000
     6. $30,000 TO $35,000
     7. $35,000 TO $40,000

TYPE IN THE NUMBER OF THE BRACKET YOU ARE IN
?4

DO YOU FILE SINGLE (1) OR JOINTLY (2)?
?2

DO YOU PAY STATE INCOME TAX?  (Y OR N)
?Y

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

DO YOU KNOW WHAT INSURANCE ON THIS PROPERTY
COSTS PER YEAR?  (Y= YES  N=NO)
?Y
INSURANCE COST PER YEAR?
?250

CAN YOU PROVIDE AN ESTIMATE OF THE ANNUAL
AMOUNT SPENT ON UPKEEP OF THE PROPERTY?  (Y OR N)
?N
YEARLY ESTIMATE, BASED ON SELLING PRICE :     $497.50

CAN YOU ESTIMATE CLOSING COSTS?  (Y OR N)
?Y
CLOSING COSTS?
?1000

DID YOU SELL THROUGH A REALTOR? (Y OR N)
?Y

DO YOU KNOW THE REALTORS PERCENTAGE?
?Y
REALTOR'S PERCENTAGE?
?6

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

ENTER ANY OTHER COSTS SUCH AS POINTS TO SELLER
FIX UP, LANDSCAPE, ADVERTISING ETC.
?1500

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$


     IT COST YOU $22413.28
     TO OWN THAT PROPERTY.

     BASED ON A SELLING PRICE OF : $99500.00
     YOUR NET RETURN IS :   $7086.72

WOULD YOU LIKE TO COMPARE THIS TO THE
ALTERNATIVE OF RENTING?
PRESS RETURN TO CONTINUE
?

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

         COMPARISON TO RENTING

WHAT WOULD IT COST PER MONTH TO RENT OR
 LEASE A SIMILAR PROPERTY?
?500
THAT FEE IS      $89.00 LESS THAN
YOUR AVERAGE MONTHLY COST OF OWNING.

WHAT IS THE HIGHEST PER CENT OF RETURN
YOU WOULD EXPECT FROM YOUR TYPICAL INVESTMENT
(SAVINGS, DEPOSIT CERTIFICATE, BOND ETC.)?
?10

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

AT THE INTEREST RATE YOU SPECIFIED, YOUR
DOWNPAYMENT AND MONTHLY INVESTMENTS WOULD
HAVE GROWN TO : $24229.00

YOUR COST FOR RENT WOULD HAVE BEEN: $19000.00
PRESS RETURN TO CONTINUE
?

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

 OWNING AND SELLING BROUGHT YOU  $27086.72
 CASH IN HAND.

 RENTING AND INVESTING BROUGHT YOU  :  $5229.00
OR (IF THE INTEREST WAS FULLY TAXED):  $1835.71
 CASH IN HAND.
READY
```

One section of the program asks for costs associated with buying and selling the property. The user must remember that costs are incurred at both ends of the transaction. Costs, such as discount points, cannot be forgotten simply because they were paid upon purchase many years ago.

Another special section allows comparison between the alternatives of owning property and leasing it. Since leasing or renting usually requires smaller monthly payments and smaller down payments or deposits, additional funds may be available for other kinds of investments. These investments may grow enough to offset lease costs.

The leasing and investing option may provide more cash in hand at the end of a given period than owning and selling. The conditions that decide this must be set by the investor. Telling the future isn't an exact science, but it can be fun.

The program itself is written in "almost anybody's big BASIC." While I used North Star BASIC to put it together, I avoided any unique string manipulations or other constructions that might make it incompatible. The input statements stand alone without any text inside them, and variables are only used in simple subscripts (such as A2). It should run in PET or TRS-80 Level II with no major modifications.

The only unique expression is %$10F2, which formats dollars and cents. Other BASICs have "print using" statements that do the same thing.

The vertical bars in the program lines separate BASIC statements and are the same as the colon in Radio Shack BASIC. I have included a table of variables (see Table 1) that will allow you to pick out any other factors you might wish to display.

Property is usually a good investment in these inflated times, but just how good is a complex question. Your computer can be a valuable aid in making investment decisions. ■

```
120   S = SELLING PRICE
140   L = AMOUNT OF THE MORTGAGE OR LOAN
160   Y3= DURATION OF MORTGAGE OR LOAN
220   A = POSTULATED ANNUAL APPRECIATION RATE
250   D = DOWNPAYMENT
270   Y = NUMBER OF YEARS OWNED
320   G = CAPITAL GAIN
410   T2= YEARLY PROPERTY TAX
430   I = INTEREST RATE ON THE MORTGAGE
460   Q2= MONTHLY PAYMENTS ON MORTGAGE
490   U2= AMOUNT OF INTEREST PAID ON LOAN YEARLY
500   U3= AMOUNT PAID ON PRINCIPAL
510   I6= TOTAL INTEREST PAID ON LOAN
520   I9= AVERAGE YEARLY INTEREST PAID
650   Z1= A SELECTION FROM THE MENU
670   Z2= A SELECTION FROM THE MENU
690   T1= THE MARGINAL BENEFIT TAX RATE
690   T3= THE DOLLAR ADDED TAX RATE
850   B$= A SELECTION FROM MENU
860   C2= ANNUAL COST OF INTEREST AND TAXES
900   C$= A SELECTION FROM MENU
930   N = INSURANCE COSTS PER YEAR
980   D$= A SELECTION FROM MENU
1000  K = ANNUAL COST OF UPKEEP
1040  D$= A SELECTION FROM MENU
1060  C1= CLOSING COSTS
1110  G$= A SELECTION FROM MENU
1130  E$= A SELECTION FROM MENU
1150  F3= REALTOR'S PERCENTAGE AS %
1160  F1= REALTOR'S PERCENTAGE AS $
1200  P = ADDITIONAL COSTS
1210  C4= SELLING EXPENSES
1220  E = TOTAL COST TO OWN PROPERTY
1220  Z = CAPITAL GAIN MINUS COSTS
1340  R1= RENTAL COST
1350  D6= DIFFERENCE BETWEEN MONTHLY RENT AND MONTHLY PAYMENTS
1380  D1= DIFFERENCE BETWEEN MONTHLY PAYMENTS AND RENT
1430  R3= % EXPECTED FROM INVESTMENTS
1450  D3= FUTURE VALUE OF DEPOSIT IF INVESTED
1460  D4= FUTURE VALUE OF D1
1470  D5= SUM OF D3+D4
1520  R7= TOTAL RENT PAID
1580  Z6= TOTAL FROM RENTING AND INVESTING
1590  F0= FUTURE INVESTED VALUE OF D1 MINUS SUM OF D1
1590  F1= FUTURE INVESTED VALUE OF DEPOSIT MINUS DEPOSIT
1590  F2= INTEREST REDUCED BY TAX
1600  F3= SUM OF F0+F1+F2+D MINUS TOTAL RENT PAID
1660  Z3= FOR NEXT LOOP COUNTER
```

Table 1. Line numbers and variables.

AT LAST!!!

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The TRS-80 Dial-a-Phone

This handle on programming lets you take your hands off the phone dial.

Allan S. Joffe W3KBM
1005 Twining Road
Dresher PA 19025

Here is an interesting, practical application for your TRS-80 in dealing with the world that exists outside your computer. To extend the TRS-80 into the realm of control you need an interface or connection to the device you wish to control. One such interface is provided with the machine: the relay contacts that start and stop the cassette machine.

The purpose of this program is to allow you use of the TRS-80 to dial your phone for you. As shown, this listing allows you to input the number, after which the computer will dial the number through the use of the simple interface I will describe.

How It Works

Fundamentally, the program causes the cassette relay to open and close under program control at two different rates. Consider that when you dial your phone you are sending out streams of pulses that correspond to the number dialed. The return time of the rotary dial introduces a delay between the dialed digits. Hence there are two rates to be considered. The first is the time between individual pulses that make up a single digit and the second is the spacing to be provided between individual digits that make up the complete phone number.

Lines 230 and 245 present the timing allowed between individual pulses within a single digit. This timing is roughly 22 milliseconds. Line 260 provides the spacing between complete digits and is roughly 220 milliseconds.

When a line such as 35 is encountered in the program, the cassette relay contacts are closed. When a line such as 220 is run, the cassette relay contacts open.

When you dial a 0, bear in mind that it does not produce zero pulses but rather produces 10 pulses. This is taken care of in the routine composed of lines 40 through 80.

Since the program prints out the dialed number on the screen, you have to reverse the above process, or whenever a 0 appears in the dialed number, a 10 will appear in the number printout. This is taken care of by line 110.

How It's Built

Fig. 1 shows the simple interface to give the computer physical control of your phone. RY-1 is a sensitive relay (I used a small reed relay) that has at least one pair of normally open (NO) contacts. It is wired in series with a voltage source to operate the relay by way of the cassette relay contacts.

I used a standard 9 volt transistor battery, which worked well for me. The reed relay contacts with the series resistor (as shown) comprise the actual interface to the outside world. Points A and B go across your incoming phone line.

When you run the program, leave your phone on the hook. When the relay closes, it is held closed for a short interval by the delay loop in line 37 of the program. This seizes the line, after which the program continues and dials the number specified in the program. Your cassette relay contacts are isolated from the phone line by the auxiliary relay, and the minute current through them is much

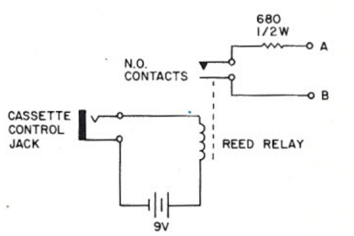

Fig. 1. Dialer interface.

```
5   DIM NUM(20)
10  PRINT "ENTER PHONE NUMBER TO BE DIALED . . ."
20  PRINT "ALL NUMBERS . . NO LETTERS . . NO SPACES . ."
30  INPUT "PHONE NUMBER DESIRED";A$
35  OUT 255,4
37  FOR Z=1 TO 1000: NEXT Z
40  FOR X=1 TO LEN(A$)
50  NUM(X)=ASC(MID$(A$,X,1))-48
60  IF NUM(X)<>0 GOTO 80
70  NUM(X)=10
80  NEXT X
100 FOR A=1 TO LEN(A$)
110 IF NUM(A)>9 PRINT 0; ELSE PRINT NUM(A);
120 NEXT A
200 FOR X=1 TO LEN(A$)
210 FOR Y=1 TO NUM(X)
220 OUT 255,0
230 FOR Z=1 TO 22:NEXT Z
240 OUT 255,4
245 FOR Z=1 TO 22: NEXT Z
250 NEXT Y
260 FOR Z=1 TO 220: NEXT Z
270 NEXT X
280 PRINT "LIFT HANDSET AND WAIT FOR YOUR PARTY TO ANSWER"
290 FOR G=1 TO 1500:NEXT G
300 GOTO 10
```

Program listing.

```
Add a line: 25 INPUT "ENTER YOUR DESIRED CODE NUMBER";D
Change line: 30 ON D GOSUB 500,510,520,530,540
```

Example 1.

less than that drawn when the cassette is turned on. This means that you do not have to worry about damaging the cassette relay contacts.

When the message shown in line 280 comes up on the screen, lift the phone's handset off the hook and wait for your called party to answer. The program goes to its finish during this time, in which it really gets set to dial the number again if you desire.

Up to this point, I have been dealing with a program and interface primarily put together by my talented son, Dan. Since I really wanted a more intelligent dialer, one with a bank of memorized, most common numbers, I made some changes to the fundamental program (see Example 1).

Next, add a series of lines corresponding to the line numbers you have written into the revised line 30 . . . using the following pattern.

```
500 A$ = "2348765":RETURN
510 A$ = "8397865":RETURN
```

You may have as many lines in the subroutine section as you wish to have phone numbers stored in the program memory. The first subroutine line would be called and its number dialed when you input a 1 when line 25 ran.

The second subroutine would be called and dialed when a 2 was entered, when line 25 was run and so on. If you wish, there is nothing to stop you from entering a hundred numbers or more into the program, each of which would be dialed merely by typing in its appropriate code number when the program asked for it.

If you have been "video bound" up to now and wish to try a control project, this is a simple way to get your feet wet. If you have either a home-brew or commercial peripheral that allows you to control a relay by means of ports other than the cassette port specified, it is easy to change the appropriate lines to use such a device rather than the cassette relay. ■

Wari

Here's a game you can play while you're planning your next meal.

L. D. Stander
P. H. Stander
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Over the years, Hollywood has taught us a great deal about primitive societies. For instance, we know that after a routine day of zapping white hunters with poison darts, most aborigines spend the evening leaping and screaming around the village fire like unfettered lunatics.

A growing body of evidence, however, indicates that some tribes in Africa and Indonesia simply have not seen enough movies. Not only do these people refrain from nocturnal cavorting, they actually prefer pastimes that demand quiet concentration and intellectual skill.

A sterling example of this astereotypic taste for things cerebral is the ancient game of mancala. Competently played, mancala can be as challenging as chess, and yet variations of the game have been found in "primitive" cultures from Ghana to the Philippines. One version, chuba, has even gained a following in less civilized regions of the Americas, such as Newark and South Philly.

Anthropologists generally agree that the game was invented by early Egyptians. In fact, the word "mancala" comes from an Arabic verb meaning "to move." During the past 30 centuries, forms of mancala have spread from Egypt to dozens of cultures and assumed names such as bau, chanka, chongkak, kpo, madji and wari.

Wari

Wari is reportedly the most popular game in West Africa. As with most forms of mancala, learning how to play wari may take all of five minutes. We selected this version for the program because of its close resemblance to the original Egyptian game.

As played by tribesmen in Africa, wari requires only two players, twelve cups and 72 playing pieces—usually pebbles or shells. The cups are arranged in two rows of six, with each player controlling one row. Six pebbles are placed in each cup, giving both players an initial total of 36.

Play begins as the first player removes all the pieces from any cup in his row and, moving in a counterclockwise direction, distributes the pieces (one per cup) among all twelve cups. The second player then does likewise. During any turn, if the last pebble falls in a cup containing only one or two other pebbles, all the pebbles in that cup are discarded and not counted in either player's total.

The game ends when, in his regular turn, a player has no pieces left to move. Please note, however, that running out of pieces means defeat only if your opponent, in his subsequent turn, can make a move that will keep all the remaining pieces in his row. The winner will always make the last move.

Don't be deceived by wari's

Program listing.

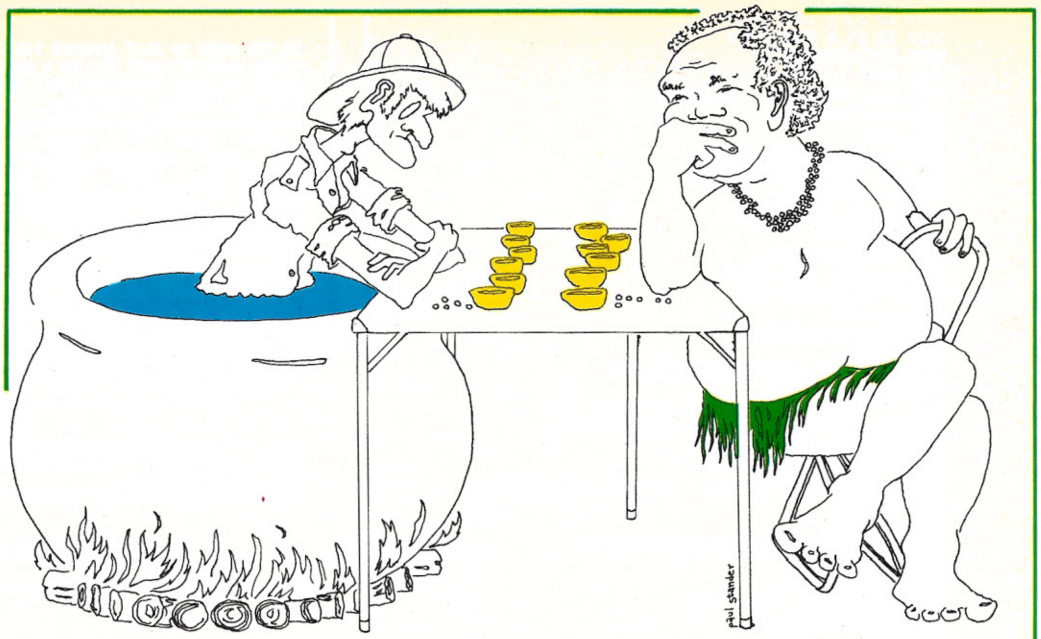
```
 120 FOR H=1 TO 80: PRINT "*";: NEXT H
 130 PRINT: PRINT
 140 PRINT TAB(30);"WARI"
 150 PRINT: PRINT
 160 FOR H=1 TO 80: PRINT "*";: NEXT H

1000 REM *** INITIALIZE ***
1010 DIM V(12),N$(2),P(2)
1020 P(1)=36: P(2)=36: Q=0: Q1=0: R=1: F=0
1030 FOR H=0 TO 11: V(H)=6: NEXT H
1040 LINE INPUT "DO YOU WISH TO PLAY AGAINST THE COMPUTER? (Y/N) ";A$
1050 IF (A$<>"Y") AND (A$<>"N") GOTO 1040
1060 S=0: IF A$="Y" THEN S=1
1070 LINE INPUT "FIRST PLAYERS NAME? (UP TO 8 CHARACTERS) ";N$(1)
1080 A=LEN(N$(1)): IF A>8 GOTO 1070
1090 IF S=1 GOTO 1130
1100 LINE INPUT "SECOND PLAYERS NAME? (UP TO 8 CHARACTERS) ";N$(2)
1110 B=LEN(N$(2)): IF B>8 GOTO 1100
1120 GOTO 1150
1130 N$(2)="COMPUTER": B=8
1140 PRINT "COMPUTERS NAME IS 'COMPUTER'."
1150 LINE INPUT "WHO GOES FIRST? (NAME) ";A$
1160 X=1: IF A$=N$(2) THEN X=2
1170 Y=ABS(X-3)
1175 IF S=0 GOTO 1200
1200 IF A=8 GOTO 1220
1210 FOR H=A TO 7: N$(1)=N$(1)+"-": NEXT H
1220 IF B=8 GOTO 1240
1230 FOR H=B TO 7: N$(2)=N$(2)+"-": NEXT H
1240 REM *** END INITIALIZE ***

2000 REM *** DISPLAY ROUTINE ***
2010 PRINT "*";
2020 FOR H=1 TO 13: PRINT "-";: NEXT H
2030 PRINT N$(1);TAB(21);
2040 FOR H=1 TO 21: PRINT "-";: NEXH H
2050 PRINT "*";SPC(4);N$(1);TAB(57);"TOTAL: ";P(1)
2060 PRINT TAB(1);"A=";V(11);TAB(8);"B=";V(10);TAB(15);"C=";V(9);TAB(22);
2070 PRINT "D=";V(8);TAB(29);"E=";V(7);TAB(36);"F=";V(6);TAB(42);
2080 PRINT "*";SPC(4);N$(2);TAB(57);"TOTAL: ";P(2)
2090 PRINT "*";
2100 PRINT SPC(5);
2110 FOR H=1 TO 30: PRINT ":";: NEXT H
2120 PRINT SPC(5);
2130 PRINT "*";SPC(4);"TOTAL DISCARDED: ";Q
2140 PRINT TAB(1);"G=";V(0);TAB(8);"H=";V(1);TAB(15);"I=";V(2);TAB(22);
2150 PRINT "J=";V(3);TAB(29);"K=";V(4);TAB(36);"L=";V(5);TAB(42);
2160 PRINT "*";SPC(4);"NO. DISCARDED: ";Q1
2170 PRINT "*";
2180 FOR H=1 TO 13: PRINT "-";: NEXT H
2190 PRINT N$(2);TAB(21);
2200 FOR H=1 TO 21: PRINT "-";: NEXT H
2210 PRINT "*";SPC(4);"ROUND NUMBER: ";R
2220 REM *** END DISPLAY ROUTINE ***
```

apparent simplicity. Only the physical aspects of the game are simple. The actual course of a game is unpredictable and often baffling. Totals will shift suddenly. A score of 35-5 can become 20-20 in a single move. It is usually impossible to tell who is ahead simply by looking at the score. The number of possible strategies is unlimited.

Like any worthy thinking game, wari is capable of raising hackles, voices and blood pressures. In fact, you may remember that the word "wari" can also be found in Old High German, where it means "to curse."



The Program

The program is arranged into five routines as shown in Fig. 1. The block title gives a rough indication of what the routine does, and the block number gives the starting line number of the routine.

The initialize routine is used to obtain information from the players and initialize several variables and tables. This routine is used only once in each game.

The display routine is used to arrange and print the game board and other game information. This routine is used once after the initialize routine and, thereafter, once per turn following the test-and-score routine.

The game-control routine is used to obtain a move from either a player or from the computer-move routine (see below). It does some testing of the acquired move and directs a valid move to the test-and-score routine. Game control also monitors for the end of a game and declares a winner.

The test-and-score routine is used to test the proposed move and handle the game bookkeeping. If the proposed move is not valid, the program will be directed back to the game-control routine to obtain a new move. The bookkeeping portion of the routine does all the scorekeeping and updates the game board after each move. When the bookkeeping is completed, the program is directed to the display routine.

The computer-move routine is used when the game-control routine requires a move from the computer. This routine is divided into five parts. Parts one through four are strategy routines. Part five decides the best move based on information provided by the strategy routines.

The program is written in Extended Benton Harbor BASIC (version 10.01.01). The printout format is arranged for best ap-

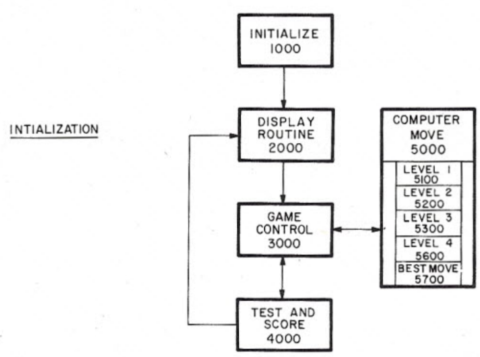


Fig. 1. Program routines.

```
3000 REM *** GAME CONTROL ***
3010 IF F=1 GOTO 3180
3020 IF X=2 GOTO 3130
3040 PRINT N$(X);" WHICH OF YOUR POSITIONS DO YOU WANT EMPTIED? ";
3050 LINE INPUT "(L) ";U$
3060 M=ASC(U$)
3070 IF X=2 GOTO 3100
3080 IF (M<65) OR (M>70) GOTO 3120
3090 GOTO 3220
3100 IF (M<71) OR (M>76) GOTO 3120
3110 GOTO 3220
3120 PRINT U$;" CANNOT BE EMPTIED BY YOU!": GOTO 3040
3130 IF S=0 GOTO 3040
3140 PRINT N$(2);" EMPTIES: ";
3150 GOTO 5000
3160 PRINT U$
3170 GOTO 3220
3180 PRINT N$(Y);" HAS NO MORE MOVES!"
3190 PRINT N$(X);" DECLARED WINNER!"
3200 PRINT "PRESS ANY KEY TO START NEW GAME."
3210 PAUSE: CLEAR: GOTO 120
3220 REM *** END GAME CONTROL ***
4000 REM *** TEST AND SCORE ***
4010 P(1)=0: P(2)=0: Q1=0
4020 M=M-65
4030 IF M>5 GOTO 4060
4040 IF M<6 THEN M=ABS(M-11)
4050 GOTO 4070
4060 M=M-6
4070 IF V(M)<>0 GOTO 4100
4080 PRINT U$;" IS ALREADY EMPTY!"
4090 GOTO 3040
4100 A=V(M): B=M+1: V(M)=0
4110 IF B=12 THEN B=0
4120 V(B)=V(B)+1: A=A-1
4130 IF A=0 GOTO 4150
4140 B=B+1: GOTO 4110
4150 IF (V(B)<2) OR (V(B)>3) GOTO 4170
4160 Q1=V(B): Q=Q+V(B): V(B)=0
4170 FOR H=6 TO 11: P(1)=P(1)+V(H): NEXT H
4180 FOR H=0 TO 5: P(2)=P(2)+V(H): NEXT H
4190 IF P(Y)<>0 GOTO 4210
4200 F=1: GOTO 4220
4210 X=ABS(X-3): Y=ABS(X-3): R=R+0.5
4220 GOTO 2000
4230 REM *** END TEST AND SCORE ***
5000 REM *** COMPUTER MOVE ***
5010 CLEAR Z(: DIM Z(5)
5020 G=1
5100 REM *** LEVEL 1 STRATEGY ***
5110 Z(0)=20: Z(1)=18: Z(2)=16: Z(3)=14: Z(4)=12: Z(5)=18
5120 FOR H=0 TO 5
5130 IF V(H)=0 THEN Z(H)=0
5140 NEXT H
5200 REM *** LEVEL 2 STRATEGY ***
5210 FOR H=0 TO 5
5220 IF V(H)=0 GOTO 5340
5230 A=V(H): B=H+1: C=20: D=2: E=0
5240 IF B=12 THEN B=0
5250 A=A-1: IF A=0 GOTO 5300
5260 B=B+1: E=E+1
5270 IF E=12 THEN D=D-1
5280 IF E=12 THEN E=0
5290 GOTO 5240
5300 IF (V(B)>D) OR (V(B)=0) GOTO 5330
```

```
5310 IF B>5 THEN C=30
5320 IF B<6 THEN C=10
5330 Z(H)=Z(H)+C
5340 NEXT H
5400 REM *** LEVEL 3 STRATEGY ***
5410 FOR H=0 TO 5
5420 A=0
5430 IF V(H)=0 GOTO 5530
5440 IF V(H)<6-H GOTO 5520
5450 A=V(H)-(5-H)
5460 IF A<7 GOTO 5520
5470 B=A: A=0
5480 B=B-12: A= A+6
5490 IF B<1 GOTO 5520
5500 IF B>6 GOTO 5480
5510 A=A+B
5520 Z(H)=Z(H)+(50-A)
5530 NEXT H
5600  REM *** LEVEL 4 STRATEGY ***
5610 A=10
5620 IF (P(1)>6) OR (P(2)>6) GOTO 5700
5630 IF P(2)<P(1) OR V(5)=0 GOTO 5700
5640 FOR H=0 TO 4
5650 IF V(H)=0 GOTO 5670
5660 Z(H)=Z(H)+A: IF V(H+1)=0 THEN Z(H)=Z(H)+30
5670 A=A+10
5680 NEXT H
5700 REM *** SELECT THE BEST MOVE ***
5710 A=0
5720 FOR H=0 TO 5
5730 IF Z(H)<=A GOTO 5750
5740 A=Z(H): U=H
5750 NEXT H
5760 M=(U+71): U$=CHR$(M)
5770 GOTO 3160
```

pearance on Heath's H9 video terminal (80 characters by 12 lines).

Computer Strategy

The computer uses a weight table to decide its move. Each level of strategy adds a value to the table for each possible move. The computer then chooses the move with the highest weight value.

Level 1 strategy weighs each move based on its position on the game board. This strategy assumes that some moves are always better because of board position.

Level 2 strategy determines for each possible move if and where playing pieces will be discarded. If a move will discard pieces on the computer's side of the board, ten will be added to the weight table. This strategy will add 30 to the table if a move causes opponent pieces to be discarded. If no pieces are discarded by a move, 20 will be added to the table.

Level 3 strategy determines how many pieces will be given to the opponent by each possible move. It then adds 50, minus the number of forfeited pieces, to the weight table.

Level 4 strategy is used only in the event both players have six or fewer pieces. If the computer has the higher number of pieces, it will sacrifice its own pieces to force the opponent to move all his pieces to the computer's side of the game board. ■

```
DO YOU WISH TO PLAY AGAINST THE COMPUTER? (Y/N) N
FIRST PLAYERS NAME? (UP TO 8 CHARACTERS) TOM
SECOND PLAYERS NAME? (UP TO 8 CHARACTERS) DICK
WHO GOES FIRST? (NAME) TOM
*-------------TOM--------------------------*     TOM----- TOTAL:  36
  A= 6   B= 6   C= 6   D= 6   E= 6   F= 6  *     DICK---- TOTAL:  36
*     ::::::::::::::::::::::::::::::       *     TOTAL DISCARDED:  0
  G= 6   H= 6   I= 6   J= 6   K= 6   L= 6  *     NO. DISCARDED:  0
*-------------DICK-------------------------*     ROUND NUMBER:  1
TOM----- WHICH OF YOUR POSITIONS DO YOU WANT EMPTIED? (L) G
G CANNOT BE EMPTIED BY YOU!
TOM----- WHICH OF YOUR POSITIONS DO YOU WANT EMPTIED? (L) A
*-------------TOM--------------------------*     TOM----- TOTAL:  30
  A= 0   B= 6   C= 6   D= 6   E= 6   F= 6  *     DICK---- TOTAL:  42
*     ::::::::::::::::::::::::::::::       *     TOTAL DISCARDED:  0
  G= 7   H= 7   I= 7   J= 7   K= 7   L= 7  *     NO. DISCARDED:  0
*-------------DICK-------------------------*     ROUND NUMBER:  1.5
DICK---- WHICH OF YOUR POSITIONS DO YOU WANT EMPTIED? (L) G
*-------------TOM--------------------------*     TOM----- TOTAL:  32
  A= 0   B= 6   C= 6   D= 6   E= 7   F= 7  *     DICK---- TOTAL:  40
*     ::::::::::::::::::::::::::::::       *     TOTAL DISCARDED:  0
  G= 0   H= 8   I= 8   J= 8   K= 8   L= 8  *     NO. DISCARDED:  0
*-------------DICK-------------------------*     ROUND NUMBER:  2
TOM----- WHICH OF YOUR POSITIONS DO YOU WANT EMPTIED? (L) A
A IS ALREADY EMPTY!
TOM----- WHICH OF YOUR POSITIONS DO YOU WANT EMPTIED? (L) F
```

Sample run 1. Player versus player.

```
DO YOU WISH TO PLAY AGAINST THE COMPUTER? (Y/N) Y
FIRST PLAYERS NAME? (UP TO 8 CHARACTERS) HARRY
COMPUTERS NAME IS 'COMPUTER'.
WHO GOES FIRST? (NAME) COMPUTER
*-------------HARRY------------------------*     HARRY--- TOTAL:  36
  A= 6   B= 6   C= 6   D= 6   E= 6   F= 6  *     COMPUTER TOTAL:  36
*     ::::::::::::::::::::::::::::::       *     TOTAL DISCARDED:  0
  G= 6   H= 6   I= 6   J= 6   K= 6   L= 6  *     NO. DISCARDED:  0
*-------------COMPUTER---------------------*     ROUND NUMBER:  1
COMPUTER EMPTIES: G
*-------------HARRY------------------------*     HARRY--- TOTAL:  37
  A= 6   B= 6   C= 6   D= 6   E= 6   F= 7  *     COMPUTER TOTAL:  35
*     ::::::::::::::::::::::::::::::       *     TOTAL DISCARDED:  0
  G= 0   H= 7   I= 7   J= 7   K= 7   L= 7  *     NO. DISCARDED:  0
*-------------COMPUTER---------------------*     ROUND NUMBER:  1.5
HARRY--- WHICH OF YOUR POSITIONS DO YOU WANT EMPTIED? (L) A
```

Sample run 2. Player versus computer.

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Micro Chroma 68 includes:

- MC6808 — Microprocessor with Clock Generator (MPU)
- MC6846P3 — RIOT with TVBug (ROM, I/O, Timer)
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- MC1372 — Video RF Modulator
- MC6850 — Asynchronous Serial Interface Adapter (ACIA)—Serial ports
- Printed Circuit Board with wirewrap area
- Data Sheets on all parts included with the kit
- Hardware/Software Descriptions
- Complete System Schematic
- Complete Parts List
- Users Manual*(with many helpful hints and patches for TSC Software)

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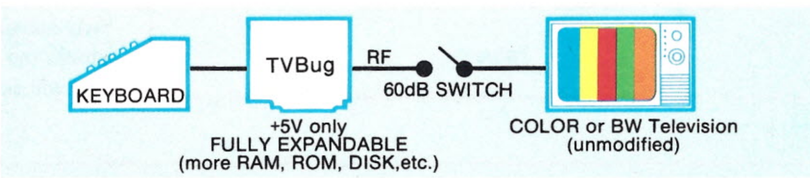
The MC6808 Advanced Microprocessor is totally software compatible with the original MC6800, and most software is easily modified for use with TVBug.



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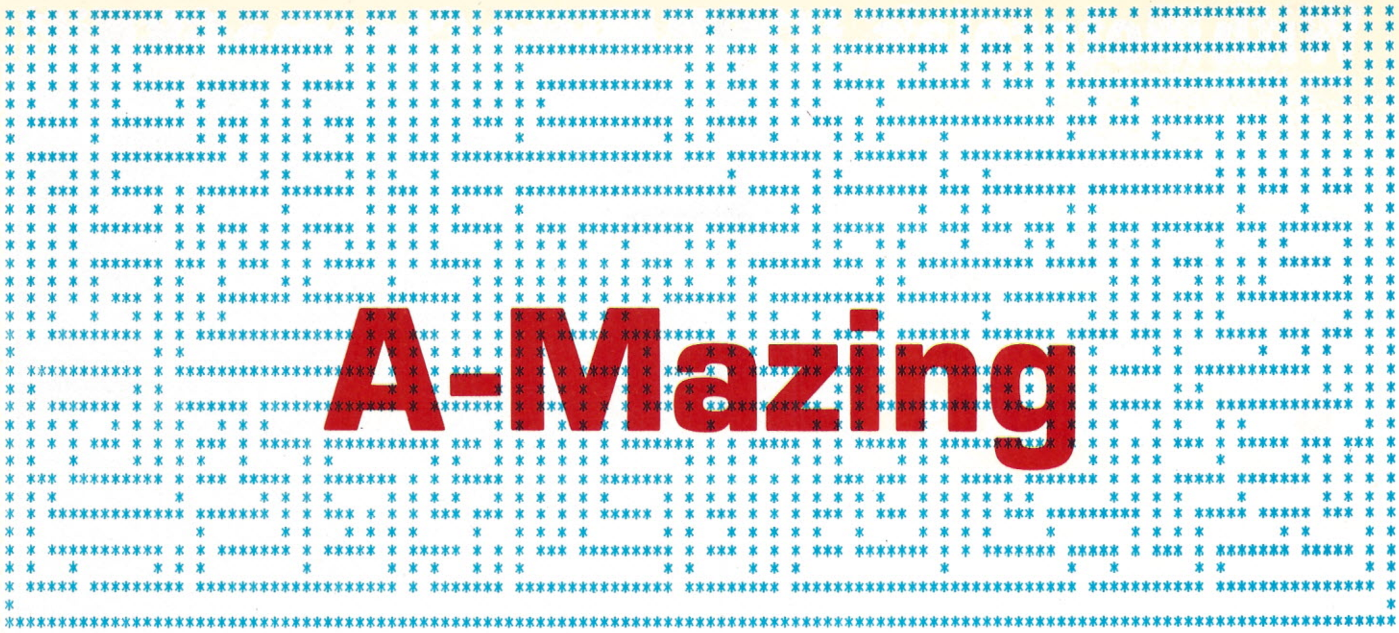

A-Mazing

This improved algorithm allows you easily to generate mazes.

Paul Wennberg
1322 Beechwood
Abilene TX 79603

This article briefly describes an efficient and elegantly simple method for generating a maze. Mazes can be tedious to do by hand, but once made can provide a few minutes, or hours, of fun. A microcomputer with even a small amount of memory can generate quite a large maze with the techniques described, thereby adding to the ever-growing number of sophisticated computer games for hobbyists.

The Daedalian Craft

To generate a maze the computer first constructs a border in which the walls of the maze are forced to stay. After this, a wall is started at a random point inside the border. The wall continues out in a random walk fashion. Eventually the wall will become trapped (see Fig. 1).

At this time the computer will retrace, or back up, until it finds an opening and then proceed with its random walk (Fig. 2). Previously backed-up walls are thereafter ignored. When the computer is forced to back up all the way to the beginning, the maze is complete.

The Programs

Program A operates the fastest; however, it is inefficient with memory. It is also the easiest to follow. The "A" array is a two-dimensional array that stores the maze. Setting A(n,m) to 1 will set the nth column and the mth row as part of a wall. A zero value will be a path. The maximum length and width of the maze is set by the "A" array and the size of your print or display device.

When the program is run, it will ask for the length and width of the maze. This is the number of lines and columns, respectively, of your output device. The computer will ensure, however, that the length and width are odd numbers. See Table 1 for a line description of Program A.

Program B is slow, but more applicable to microcomputers because of memory efficiency. Instead of an array A(132,132) of real numbers storing only 0s and 1s, it is simple to reduce the array to A(11,132) and pack the 0s and 1s manually. For example, twelve 0s or 1s can be stored in a real number from 0 to 4095. Of course, larger packing den-

Lines	Remarks
140-145	Clears the array
150-160	Sets the border
170-180	Sets the starting point
210-240	Tests if trapped
260-290	Backs up
320	Chooses random length
340	Chooses random direction
440-460	Tests whether or not the wall will run into another
470-490	Inserts wall
560-600	Prints maze

Table 1.

```
       DIM A(11,132)
       N =        :M =
       GOSUB 750
           .
           ..
           .
750    H = INT((N - 1)/12) + 1
760    B = N - (H - 1)*12
770    B2 = 1:IF B = 1 GOTO 790
780    FOR P = 1 TO B - 1:B2 = B2*2:NEXT P
790    A(H,M) = A(H,M) + B2
800    RETURN
```

Subroutine 1. A(N,M) = 1; 1⩽N, M⩽132.

```
       N =        :M =
       GOSUB 810
           .
           .
           ..
810    V = 1:H = INT((N - 1)/12) + 1
820    B = N - (H - 1)*12
830    Z = A(H,M)
840    IF B = 1 THEN 880
850    FOR P = 1 TO B - 1
860    Z = INT(Z/2)
870    NEXT P
880    IF Z/2 = INT(Z/2) THEN V = 0
890    RETURN
```

Subroutine 2. V = A(N,M); 1⩽N, M⩽132.

```
       N =        :M =
       GOSUB 900
           .
           .
           .
900    GOSUB 810
910    IF V = 0 THEN RETURN
920    H = INT((N - 1)/12) + 1
930    B = N - (H - 1)*12
940    B2 = 1:IF B = 1 GOTO 960
950    FOR P = 1 TO B - 1:B2 = B2*2:NEXT P
960    A(H,M) = A(H,M) - B2
970    RETURN
```

Subroutine 3.

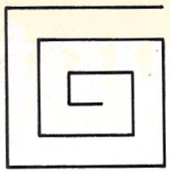

Fig. 1.

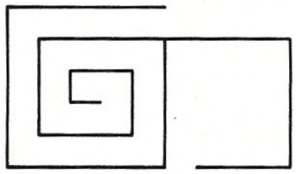

Fig. 2.

sities are possible. See Subroutines 1 and 2.

In this program there is never any reason to set an array value to 0. To set an individual value to zero, see Subroutine 3.

For the maximum maze size of 131 x 131 (131 columns by 131 lines on a hard-copy printer), the program took 1½ hours to compute and ½ hour to print using an Imsai 8080 connected to a DECwriter. Refer to the Program B sample run as an example.

Line 670 in Program B was added to monitor the program's progress on a CRT display. It is interesting to imagine the computer building walls and back up by watching the variable K.

At this point you may wonder where the start and finish are. No matter where you put the start and finish, there is only one solution, except in the case where you reach the border, and then there are two solutions depending on whether you move clockwise or counterclockwise.

I wish to thank Ed Grant (KB5AL) for the use of his beautiful computer system, which uses TDL 8K BASIC. The program should work with most BASIC interpreters and has been carefully written to avoid rounding errors in the subroutines.

Modifications of the output are possible. If your printer has a 1/8-inch line spacing feature, you are in luck. Graphic output devices would make great-looking mazes. The computer does not give a solution. I will leave that as a challenge to you hard-working programmers. ■

```
10 REM MAZE GENERATING PROGRAM
13 REM BY PAUL WENNBERG
100 DIM A(64,64), L2(500),D2(500)
110 INPUT "WIDTH";W:W=INT(W/2)
120 INPUT "LENGTH";L:L=INT(L/2)
130 N=2*W+1:M=2*L+1
140 FOR I=2 TO N-1:FOR J=2 TO M-1:A(I,J)=0
145 NEXT J:NEXT I
150 FOR I=1 TO N:A(I,1)=1:A(I,M)=1:NEXT I
160 FOR I=1 TO M:A(1,I)=1:A(N,I)=1:NEXT I
170 NN=2*INT(RND(1)*(W-2))+3
180 MM=2*INT(RND(1)*(L-2))+3
190 A(NN,MM)=1:K=0
210 IF A(NN-2,MM)=0 THEN 320
220 IF A(NN+2,MM)=0 THEN 320
230 IF A(NN,MM-2)=0 THEN 320
240 IF A(NN,MM+2)=0 THEN 320
250 IF K-1=0 THEN 560
260 IF D2(K)=1 THEN NN=NN+L2(K)
270 IF D2(K)=2 THEN NN=NN-L2(K)
280 IF D2(K)=3 THEN MM=MM+L2(K)
290 IF D2(K)=4 THEN MM=MM-L2(K)
300 K=K-1
310 GOTO 210
320 L1=2*INT(RND(1)*3)+2
330 IF L1=8 THEN 320
340 D1=INT(RND(1)*4)+1
350 IF D1=5 THEN 340
360 IF D1>2 THEN 410
370 S=-1
380 IF D1=2 THEN S=1
390 T=0
400 GOTO 440
410 S=0
420 T=-1
430 IF D1=4 THEN T=1
440 FOR I=2 TO L1 STEP 2
450 IF A(NN+S*I,MM+T*I)=1 THEN 320
460 NEXT I
470 FOR I=1 TO L1
480 A(NN+S*I,MM+T*I)=1
490 NEXT I
500 NN=NN+S*L1
510 MM=MM+T*L1
520 K=K+1
530 L2(K)=L1
540 D2(K)=D1
550 GOTO 210
560 FOR I=1 TO M
570 FOR J=1 TO N
580 IF A(J,I)=1 THEN PRINT "*";
590 IF A(J,I)=0 THEN PRINT " ";
600 NEXT J:PRINT:NEXT I:END

>READY
```

```
RUN
WIDTH? 45
LENGTH? 40
*********************************************
*                                           *
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>READY
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Program A and sample run.

```
100 REM MAZE GENERATING PROGRAM
110 REM BY PAUL WENNBERG
120 REM  SET PRINTER WIDTH
130 WIDTH 132
140 DIM A(11,132), L2(1000),D2(1000)
150 REM SET WIDTH AND LENGTH
160 REM OF MAZE.
170 INPUT "WIDTH";W:W=INT(W/2)
180 INPUT "LENGTH";L:L=INT(L/2)
190 REM CLEAR THE ARRAY
200 FOR I=1 TO 11:FOR J=1 TO 132
210 A(I,J)=0:NEXT J:NEXT I
220 I=2*W+1:J=2*L+1:FOR N=1 TO I
230 M=1:GOSUB 750:M=J:GOSUB 750
240 NEXT N:FOR M=2 TO J-1:N=1
250 GOSUB 750:N=I:GOSUB 750:NEXT M
260 REM PICK A STARTING POINT
270 NN=2*INT(RND(1)*(W-2))+3
280 MM=2*INT(RND(1)*(L-2))+3
290 N=NN:M=MM:GOSUB 750:K=0
300 N=NN-2:M=MM:GOSUB 810
310 IF V=0 THEN 440
320 N=NN+2:M=MM:GOSUB 810
330 IF V=0 THEN 440
340 N=NN:M=MM-2:GOSUB 810
350 IF V=0 THEN 440
360 N=NN:M=MM+2:GOSUB 810
370 IF V=0 THEN 440
380 IF K-1=0 THEN 690
390 IF D2(K)=1 THEN NN=NN+L2(K)
400 IF D2(K)=2 THEN NN=NN-L2(K)
410 IF D2(K)=3 THEN MM=MM+L2(K)
420 IF D2(K)=4 THEN MM=MM-L2(K)
430 K=K-1:GOTO 300
440 L1=2*INT(RND(1)*3)+2
450 IF L1=8 THEN 440
460 D1=INT(RND(1)*4)+1
470 IF D1=5 THEN 460
480 IF D1>2 THEN 530
490 S=-1
500 IF D1=2 THEN S=1
510 T=0
520 GOTO 560
530 S=0
540 T=-1
550 IF D1=4 THEN T=1
560 FOR I=2 TO L1 STEP 2
570 N=NN+S*I:M=MM+T*I:GOSUB 810
580 IF V=1 THEN 440
590 NEXT I
600 FOR I=1 TO L1
610 N=NN+S*I:M=MM+T*I:GOSUB 750
620 NEXT I
630 NN=NN+S*L1:MM=MM+T*L1
640 K=K+1
650 L2(K)=L1
660 D2(K)=D1
670 LPRINT K
680 GOTO 300
690 FOR M=1 TO 2*L+1
700 FOR N=1 TO 2*W+1
710 GOSUB 810
720 IF V=1 THEN PRINT "*";
730 IF V=0 THEN PRINT " ";
740 NEXT N:PRINT:NEXT M:END
750 H=INT((N-1)/12)+1
760 B=N-(H-1)*12
770 B2=1:IF B=1 GOTO 790
780 FOR P=1 TO B-1:B2=B2*2:NEXT P
790 A(H,M)=A(H,M)+B2
800 RETURN
810 V=1:H=INT((N-1)/12)+1
820 B=N-(H-1)*12
830 Z=A(H,M)
840 IF B=1 THEN 880
850 FOR P=1 TO B-1
860 Z=INT(Z/2)
870 NEXT P
880 IF Z/2=INT(Z/2) THEN V=0
890 RETURN

>READY
RUN
WIDTH? 30
LENGTH? 20
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>READY
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Program B and sample run.

Get a Software Discount!

Now you can get the best for less! Just clip out the coupon at right, bring it to your local computer store, and you'll get $1.00 off the list price of any program package from Instant Software!

All Packages $7.95 except where otherwise indicated.

TRS-80*

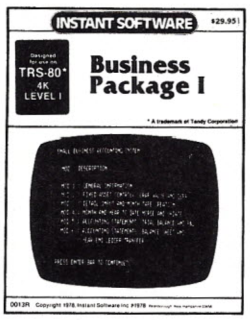
Level I

Knight's Quest/Robot Chase/Horse Race
16K; Order No. 0003R.

Cave Exploring/Yacht/Memory 16K; Order No. 0010R.

Status of Homes/Auto Expenses 4K; Order No. 0012R.

BUSINESS PACKAGE I



When the TRS-80 first appeared on the market, businessmen everywhere became excited at the prospect of bringing the computer's convenience and versatility to their businesses at unprecedented prices. Thanks to Instant Software, that dream is now a reality. Actually six separate programs, Business Package I contains all the software you'll need to maintain the books for your company—and on the least expensive TRS-80 produced. The computer will list your fixed assets and term depreciation; allow for the creation of tape files for fast access to your general ledger and other information; compute year-to-date ledger from monthly ledger data; compute trial balance and profit-and-loss statements; and combine all data to produce a year-end balance. Package furnished complete with blank data cassette and detailed instructions for use.
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Demo I 4K; Order No. 0020R.

Destroy All Subs/Bomber/Gunboats 4K; Order No. 0021R.

Personal Finance I 4K; Order No. 0027R.

Doodles and Displays I 16K Order No. 0030R.

Space Trek III 4K; Order No. 0031R.

Fun Package I 16K; Order No. 0037R.

Hex Pawn/Shuttle Craft Docking/Space Chase/ Sea Battle
16K; Order No. 0041R.

BUSINESS PACKAGE III

Sales are the lifeblood of virtually any business. With Business Package III, you'll be able to maintain inventories and work out discounts and commission percentages on your computer, giving your customers the fast answers they need and leaving you more time in the field.

Inventory

Why spring for a larger computer when you can maintain a full running inventory of up to 1153 items, showing stock number, quantity, and price, on your TRS-80? The program allows you to search for individual items or to review your entire inventory one block at a time. The program is so simple to run that your employees will be able to use it with only minimal training.

Discount and Commission Percentages

This automated business function program is just the tool you need to handle so many of your daily calculations. Any retail or wholesale company can benefit from fast, easy access to the following information:

Selling Price
Percent Markup
Total Selling Price
Discount Percentage
Actual Price
Percent Change
Percent Profit

For the 4K Level I.
Order No. 0061R $7.95

Level I and II

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Golf/Crossout 4K L.I, 16K L.II; Order No. 0009R.

Air Flight Simulation 4K L.I, 16K L.II; Order No. 0017R.

Oil Tycoon 4K L.I, and L.II; Order No. 0023R.

BEGINNER'S BACKGAMMON/KENO Why sit alone when you can play these fascinating games with your TRS-80?

- **Backgammon**—Play against the computer. Your TRS-80 will give you a steady, challenging game that's sure to sharpen your skills.
- **Keno**—Enjoy this popular Las Vegas gambling game. Guess the right numbers and win big.

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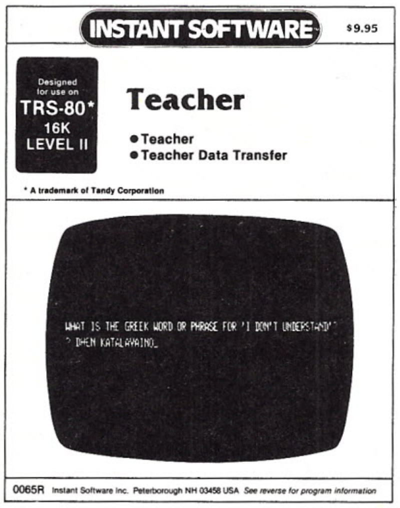
Santa Paravia and Fiumaccio
4K L.I, 16K L.II; Order No. 0043R.

Level II



TEACHER

For decades, leading educators and computer scientists alike have been touting the future role of computers in education. Now you and your family can reap the benefits of computer-assisted instruction in the comfort of your own home. This practical program allows you to input any number of questions and answers from the fields of science, languages, history—you name it. Using this data, the computer will prepare several types of tests, quiz students—providing up to three hints per question—even offer graphic rewards for younger children, all at the user's discretion.

Teacher Data Transfer

This time-saving program allows the instructor to record several tests sequentially on a single cassette, thereby permitting the administration of whole lessons without the inconvenience of changing cassettes.

Teacher is effective, practical, easy to use—perfect for teachers, parents, businessmen or anyone faced with learning a lot of material in the shortest possible time. Furnished with blank data cassette.
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Model Rocket Analyzer and PreFlight Check
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TRS-80 UTILITY 1 Ever wonder how some programmers give their programs that professional look? Instant Software has the answer with the TRS-80 Utility 1 package. Included are:

- **RENUM**—Now you can easily renumber any Level II program to make room for modification or to clean up the listing.
- **DUPLIK**—This program will let you duplicate any BASIC, assembler, or machine-language program, verify the data, and record the program on tape. You can even do Level I programs on a Level II machine.

For the TRS-80 Level II 16K. **Order No. 0081R $7.95.**

TRS-80 UTILITY 2 Let Instant Software change the drudgery of editing your programs into a quick, easy job. Included in this package are:

- **CFETCH**—Search through any Level II program tape and get the file names for all the programs. You can also merge BASIC programs, with consecutive line numbers, into one program.
- **CWRITE**—Combine subroutines that work in different memory locations into one program. This works with BASIC or machine-language programs and gives you a general checksum.

This package is just the thing for your TRS-80 Level II 16K. **Order No. 0076R $7.95**

PET**

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- **Mortgage with Prepayment Option**—Calculate mortgage payment schedules and save money with prepayments.
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All you need to become a financial wizard with an 8K PET. **Order No. 0006P $7.95.**

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Bowling/Trilogy 20K; Order No. 0040A.

Math Tutor I Applesoft II + 24K Order No. 0073A.

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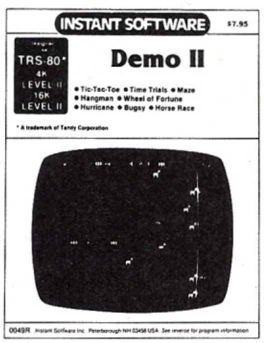
TRS-80*



DEMO II The company that brings your customers more programs for the dollar is proud to offer Demo II, an extraordinary package that contains programs to suit their every mood:

•**Tic-Tac-Toe** — Fun for the whole family! Everyone knows the rules, and this version gives your customers three different levels of difficulty, one of which is sure to suit everyone in the family!

•**Time Trials** — Your customers won't even have to leave their houses to experience "pre-race" excitement. It's them against the clock as they maneuver their cars through the curves, chutes, and chicanes of the computerized course.

•**Maze** — Somewhere within a ponderous maze, the secret home square waits to be discovered. If your customer wants to play against a friend, the computer will be happy to offer a two-player version so that they can both race to see who can uncover his square first! Amazing.

•**Hangman** — How many people have grown up playing different versions of that old grade school standby, hangman? If your customers have never played the game on a computer, they're in for a special treat! The player or the computer will supply the word. With each wrong guess, the poor hangman's figure grows — and only your customer can spare him!

•**Wheel of Fortune** — "There's one born every minute," or so goes the old saw. In this simulation of the carnival wheel of fortune, your customers have the choice of the regular or the "crooked" version, where they can't help but win. The casino will even give them the keys to the place!

•**Hurricane** — Here's a program that will let your customers chart the path of oncoming hurricanes anywhere in the world, using data available from the National Weather Service.

•**Bugsy** — Sure, everybody talks about computer bugs, but how many people have ever seen one? In this game, the computer rolls the dice and competes with your customer to see who will be the first one to complete his "Z-80 Bug."

•**Horse Race** — Now your customers can go to the races every day! Up to 100 bettors can cheer their horses to the finish line with their choice of win, place, or show. For the TRS-80 Level II 16K. **Order No. 0049R $7.95.**

DEMO III This is the big one: big on value, big on fun — the perfect package for the beginner and old hand alike. Check out this list of programs!

•**Race 1** — It's your customers against the clock as they careen around the track in this simulation of a high-speed car race.

•**Target UFO** — Your customers must try to rack up a big score by destroying all the UFO's in the shortest possible time.

•**Life** — Give your customers the opportunity to experiment with population density factors in this simulation of the life cycle of a colony of bacteria.

•**Phone Number Converter** — Your customers' computers can figure out clever words for all of their hard-to-remember phone numbers.

•**Biorhythm** — Fact? Or fantasy? Who can say for sure? In any case, your customers and their friends will be able to plot their biorhythmic curves whenever they want!

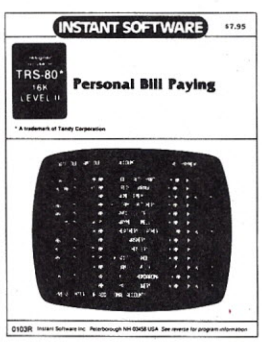
•**Graphics Program** — No user commands, your customers can just sit back and enjoy as their TRS-80 demonstrates its artistic abilities.

•**Race 2** — After they've mastered Race 1, your customers will be ready for this more advanced version — with a choice of five different tracks!

•**Horse Race** — Up to nine players can place their bets and watch the ponies run. The computer will keep track of the winnings.

•**Drawing Board** — The TRS-80 supplies the "pencil and paper," and your customers supply the ability. Messages or drawings may be stored on cassette for later unveiling.

•**24-Hour Clock** — That's right, this program allows the computer to act as a digital timepiece. Perfect for sporting events. For the TRS-80 Level II 4K and Level II 16K. **Order No. 0055R.**



PERSONAL BILL PAYING No longer will your customers have to thrash around with bills, trying to figure out what to pay whom, and when. Instant Software presents: Personal Bill Paying.

This advanced system goes far beyond simple checkbook programs. With Personal Bill Paying, your customers can keep a computerized list of all their bills, with up to 22 accounts, each listed with its name, number, due date, and amount owed.

Individual accounts can be displayed with a month-by-month breakdown of payments (including check numbers). Current accounts can be separated from inactive ones and listed along with all other pertinent information.

The package even includes options that let your customers save their data on tape for future use and easily delete or alter accounts.

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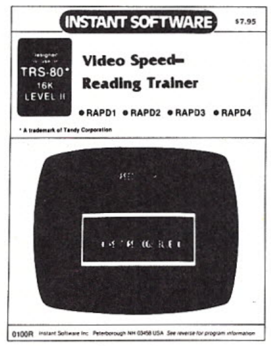

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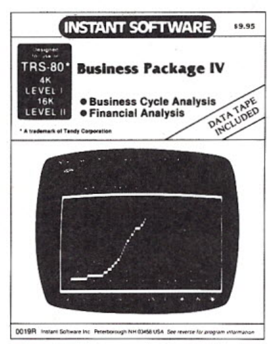

BUSINESS PACKAGE IV — Business Package IV gives the businessman a superb tool for helping make those important decisions. This package includes:

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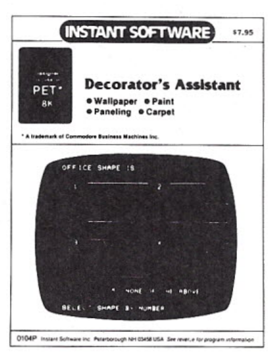
PET**



DECORATOR'S ASSISTANT Quick, how much wallpaper, paint, paneling, and carpeting are needed to redo a room measuring 11 x 12 feet with two windows and one door? Who wouldn't cringe at the thought of doing all those calculations to find the square feet of the materials needed and their total cost?

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Ray Tully
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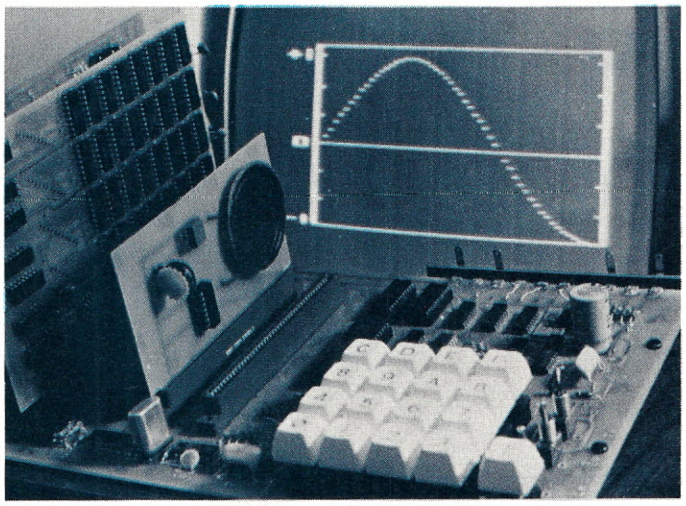
Elfin Echoes

Add sound to your Elf II cassette tape interface.



Elf II with audio output (small vertical boad), 4K memory, sine wave.

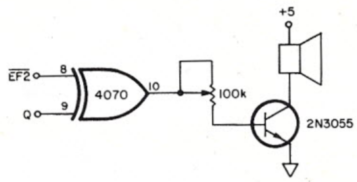


Fig. 1. Circuit configuration for the audio output. The speaker is a small 8 Ohm type.

In order to simplify program loading and recording through the cassette tape interface of the Elf II microcomputer, it is desirable to monitor both incoming and outgoing signals with an audio amplifier. Normally, this would require manually switching back and forth between the two channels, which can be inconvenient. An alternative is the simple circuit presented here, which simultaneously monitors both channels used in the tape interface of the Netronics Giant Board. The printed circuit plugs directly into the Elf's bus (see accompanying photo).

The Circuit

The circuit (Fig. 1) uses a CMOS 4070 exclusive OR gate as a 1-of-2 data transmission gate. The gate's inputs are connected to the Elf's Q line (active during recording) and the $\overline{EF2}$ line (active during tape playback). An exclusive OR is used so that data entering on one line will reach the output regardless of the state of the other line. Although holding one of the lines high while entering data through the other will cause the output to be inverted, this has no effect on the sound from the speaker. I used a 2N3055 power-tab transistor to drive the speaker, but other similar transistors should work equally well. A 100k or 500k potentiometer serves as a volume control.

A printed circuit pattern for the project is shown in Fig. 2. When plugged into the Elf, the board's contacts will be on the left side of the edge connector, which is the side left open to user connections. To complete the circuit, connect pin 17 to 18 (Q line), pin 69 to 70 ($\overline{EF2}$) and pin 79 to 80 and/or 81 to 82 (GND). The +5 V connections are already made.

To test the circuit, first run any program that toggles Q on and off. If this is heard on the speaker, try playing a tape into the Giant Board interface. It is not necessary to call the system monitor to play a tape over the speaker, as the connection is always made. Next, play a tape while Q is on, or while Q is slowly toggled. If this has no effect on the output, then the test is complete. ■

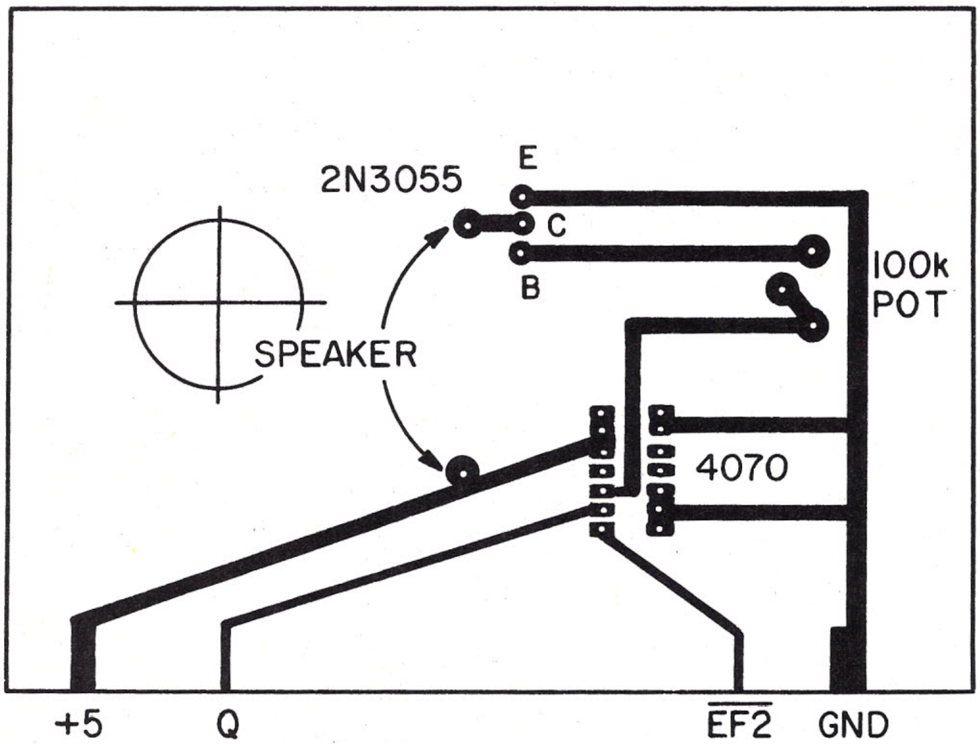


Fig. 2. Printed circuit pattern for the reverse side of the board. A hole is drilled where indicated for mounting the speaker.

Sherlock Holmes and the Computer

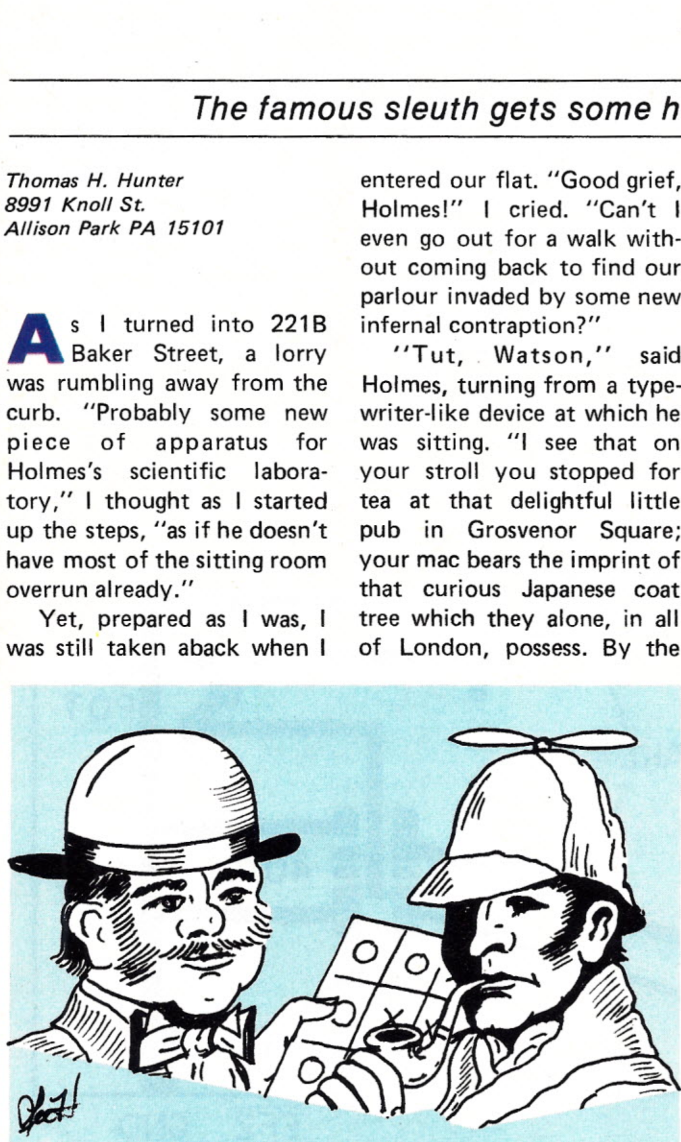
The famous sleuth gets some help from an improbable assistant.

Thomas H. Hunter
8991 Knoll St.
Allison Park PA 15101

As I turned into 221B Baker Street, a lorry was rumbling away from the curb. "Probably some new piece of apparatus for Holmes's scientific laboratory," I thought as I started up the steps, "as if he doesn't have most of the sitting room overrun already."

Yet, prepared as I was, I was still taken aback when I entered our flat. "Good grief, Holmes!" I cried. "Can't I even go out for a walk without coming back to find our parlour invaded by some new infernal contraption?"

"Tut, Watson," said Holmes, turning from a typewriter-like device at which he was sitting. "I see that on your stroll you stopped for tea at that delightful little pub in Grosvenor Square; your mac bears the imprint of that curious Japanese coat tree which they alone, in all of London, possess. By the various hairs on your sleeve I would say that you have enjoyed the company of at least four different ladies. The splashes on your back are of a yellowish mud peculiar to Wadlow Street in the North Quarter, and from the soot and grime on your sleeves I would guess that you have been working in a mill for about five years. Quite remarkable, really, for an hour-and-a-half walk."



"I reached behind the reddening detective to pluck the paper from the machine."

"My gosh!" said I, staring at the ragged sleeves which covered my arms, "I picked up the wrong mac in the pub! But Holmes, what is this wheezing, clanking conglomeration of balloons and hoses? Surely you haven't given up your violin for a calliope?"

Holmes smiled at my naiveté. "You are gazing upon the marvel of the century – the TESLAVAC general-purpose data-processing system."

"Huh?" I said, mouth agape.

"We are going to see the end of crime in London, Watson, thanks to this 'infernal contraption,' as you call it."

"But what does it do, Holmes?"

"Anything, Watson! That's the beauty of it – a machine that is not restricted to a single task, but can do anything you ask of it."

"But what is it doing now?"

"Er, nothing really," muttered Holmes as he tried to block my view of the clattering typewriter.

"I say!" I said, as I reached behind the reddening detective to pluck the paper from the machine. "It looks to me, Holmes, as though this apparatus has beaten you hands down at crosses and draughts."

The following week found Holmes continuously at work at his computer, as he was fond of calling it. The air was thick with the clankings of the machine and billows of acrid smoke from his puffing pipe. On the eighth day after the arrival of TESLAVAC, he finally came up for air.

"Well, Watson," he said, opening the windows to let in the cool September breeze, "I suppose you are dying with

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curiosity to know how this marvelous device operates."

"Indubitably," I said, stifling a yawn and trying to look interested.

"This machine operates on air pressure as do the older and now obsolete analogue systems, but with two important differences.

"First, the old method used air pressure over a wide range to stand for numbers over an equal range, a positive pressure for a positive number and a negative pressure, or vacuum, for a negative number. The usable numeric range was limited, as you might imagine, by the strength of the hoses. This posed a severe restriction on the use of analogue computers.

"The largest machines used reinforced steel pipe in the arithmetic units; but this was only a partial solution. Although they could handle larger numbers, they became quite hazardous. A numeric overflow was now more serious than a simple burst hose.

"The day of the analogue computer was considered to have ended several years ago when the giant machine at the University of Moscow Computation Center exploded while calculating the effectiveness of a new toothpaste, killing four mathematicians, two operators and thirty-seven steamfitters.

"The new *digital* computers, as they are called, and of which the TESLAVAC is an admirable example, use but two discrete air pressures — zero and five pounds per square inch — thus eliminating the possibility of the dangerous pressure buildups, which caused so many analogue disasters.

"And that brings us to the second major difference — all numbers are represented by just these two air pressures."

"But Holmes," I said aghast, "that is not possible."

"That, my good Doctor, is where you are wrong," replied Holmes, who then spent the rest of the day demonstrating how any mathematical computation could be done using only two numerals. He showed me examples, such as one times one, and one divided by one.

I confess that all of this was well over my head; and considering his remarkable lack of success, I even wondered if my friend fully understood the principles he so glibly expounded. But only one who was not aware of his great scientific intellect would have doubted the abilities of the man, as he somewhat vainly tried to prove that any conceivable computation could be performed using only the numbers one and two.

Fortunately, just before Holmes's rapidly deteriorating temper reached the danger point, our landlady came to the door with a telegram in her hand. After she had retreated, Holmes vented his anger upon the hapless envelope by tearing it into small shreds.

It quickly became apparent that his somewhat improved humour was not to last. As he read the telegram I saw his jaw tighten convulsively with a crunch and clatter as he bit his favorite meerschaum in two, and the severed bowl fell to the floor, setting the rug afire.

"What is it, Holmes?" I asked as I stomped out the flames.

"Faugh!" he exclaimed and spat, nearly missing the cuspidor in his agitation. "A challenge from my arch rival, Professor Moriarty . . . his computer against mine at the most difficult game ever devised by the mind of man — *Monopoly!*"

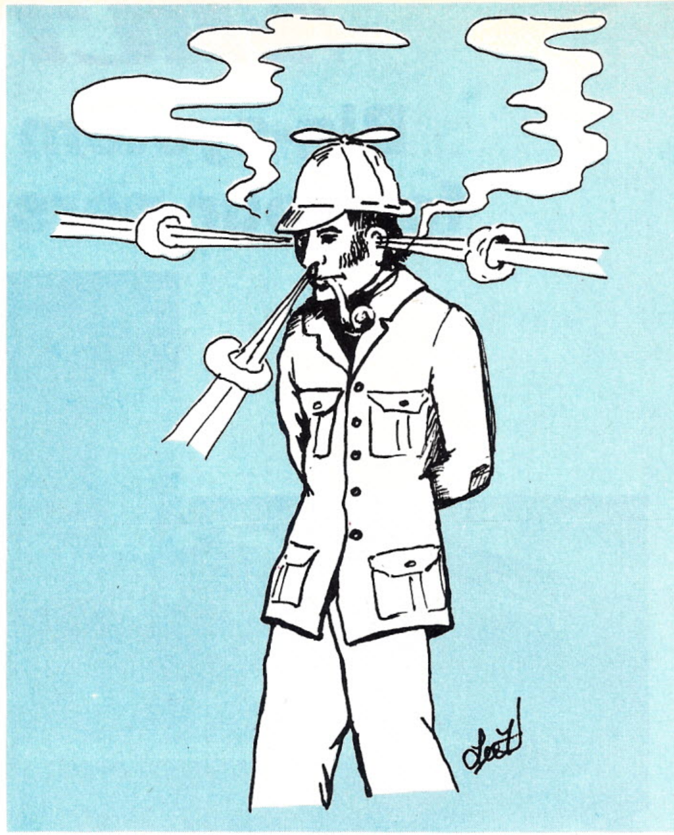
"Marvelous!" I shouted, "just the chance you've been hoping for."

"An insult," retorted Holmes.

"How so?" I asked, chagrined.

"His machine is an *Edison Analogue*. Faugh!" spat Holmes. This time he did miss.

The next evening Holmes



"The sound of his pacing thundered through the flat."

was still in a foul mood. The burned spot in the rug was now accompanied by a well-worn path from his incessant pacing; and the air was sooty with smoke from his hastily repaired pipe. As I finished my evening meal he turned and faced me through the slowly settling fly ash.

"I give the man credit, Watson," he said. "He has me on the spot, so to speak. If I refuse I will become the laughingstock of the underworld."

"Then accept," I suggested.

"And walk into a trap," he said, and resumed pacing. "The man is cunning, Watson. He offers a challenge that I dare not refuse, yet cannot win. You see, despite its problems, there are certain calculations which can best be done on the analogue computer."

"And Monopoly is one of them!" I cried, as I realized his predicament.

"Exactly. The man is a fiend, but a clever fiend. There is no help for it, Watson; I must play out this farce to the bitter end."

"Blimey," I said, dumbfounded.

The sound of his pacing thundered through the flat. The little propeller on his deerstalker cap whirled furiously, and I am not sure but that some of the dense smoke trailing behind him did not come from his ears. Finally he halted, slamming his fist on the sideboard and nearly splintering it.

"Set up the board, Doctor. You know my piece — the little silver top hat. It is time I started programming."

I will not describe the rest of that month as Holmes played countless games while he refined his instructions to the machine and slowly improved its skill. The flat was littered with houses, hotels and shredded community-chest cards. The floor was knee deep in the eight-and-a-half inch wrapping paper that his automatic typewriter consumed by the roll. Suffice it to say that at last Holmes was satisfied that no further

improvement was possible.

He wired the professor that all was ready; and the contest was set for the following day.

The big day dawned bright and clear as Holmes and I were stringing a bundle of hoses over the back fence to the small park in Wellington Square, which had been chosen for the meeting because of its central location between our small flat and Professor Moriarty's mansion. Several of the Professor's ruffians were already setting up his apparatus, as we arrived with a remote typewriter to communicate via the hoses with the computer in our rooms.

"Moriarty smiled through clenched teeth, 'Would you like to trade?' "

As Holmes busied himself with the final connections, I was free to study our opponent's installation. It was not at all like ours, being a sizable collection of valves and pressure gauges mounted in orderly rows on a wooden frame. This was connected to a bundle of hoses, several times larger than ours, neatly suspended on gaslamp posts until it disappeared around the bend on Pierce Avenue. I glanced at our own hastily stretched line — and, in so doing, caught Holmes's eye.

"Some day, Watson, every building in London will be linked by a network of hoses such as these to carry information from office to office at nearly the speed of a racehorse."

As he talked, he sauntered over to the momentarily deserted analogue console.

"And after that, perhaps the world. Oh, Watson, would you check our hose where it lies on that picket fence? I'm afraid it might be pinched."

I walked to the edge of the park to check the hose in question and saw that it had become wedged between two slats of the fence. It was but a moment's work to free it. As I returned to our typewriter, Holmes was still standing at our opponent's installation, his hands deep in his pockets.

"It looks as though we are about to start," he said, turning. "Here comes our worthy adversary, and over there, I believe, is Inspector Lestrade."

Indeed, Professor Moriarty and his bully squad were coming down Pierce Avenue; and young Inspector Lestrade, with the playing board under his arm, was approaching from across the square, flanked by two constables. It had been agreed that the contest would take place under Lestrade's watchful eye and that he would also be banker. Furthermore, at Moriarty's insistence, the game was to be played with real money. "Just to make it interesting," he had said.

For Moriarty, of course, the money was no problem; and although Holmes led a miserly existence, his bank account was not inconsiderable owing to the generosity of many wealthy clients for whom he had performed services. Still, because of the large sums that would certainly change hands during the course of the game, my friend stood a fair chance of spending his retired years selling breadcrumbs to tourists on the steps of Saint Paul's.

The board was quickly set up, and each contestant placed ten thousand pounds into the hands of Lestrade to finance the bank. The initial monies were then counted out, and a preliminary toss of the dice determined that Holmes's machine would have the first roll.

The constable assigned to Holmes threw the cubes for a three, and Holmes rapidly entered the data with his remote typewriter. "Buy" was the word that flashed back, so sixty pounds and the deed to Baltic Avenue changed hands.

Seven for Moriarty, and his constable picked up a card from the chance pile: "Take a walk on the Boardwalk." Four hundred pounds went into the bank; and Moriarty received the deed, as he continued to spin dials to inform his machine of the progress of the game.

Two for Holmes, whose machine advised him to buy the Reading; and five to make him a visitor at the Jail. He started to sweat as Moriarty received two fives, passed Go, rolled again and bought Connecticut Avenue and Saint James Place — all in the same turn.

Agonizing hours later, as the sun approached its zenith and passersby on their lunch breaks watched the strange spectacle in rapt concentration, Holmes had managed hotels on Baltic and Mediterranean. He held three railroads and both utilities, two yellows, two greens and one light violet. Moriarty had hotels on all three oranges and three houses each on the reds. He also held two light violets, two light blues, the Short Line, the remaining yellow and green and, of course, Boardwalk.

Oriental Avenue and Park Place were still unsold, and the players still held approximately equal reserves of cash. The bank, it had been decided, would be divided between its investors in proportion to the value of property held by each at the conclusion of the game, less a modest percentage to be donated to the Bobbies' Charity Fund in return for the officers' cooperation in overseeing the contest.

Holmes's silver top hat was resting on his own Pennsylvania Avenue, safely between his opponent's properties of North Carolina Avenue and the Short Line. As the constable rolled the dice, I fervently hoped Holmes would pass Go without encountering either the Luxury Tax or the rent of the Boardwalk.

The dies settled. A three! Our machine promptly responded to this information by insisting on nothing less than the immediate purchase of Park Place, which fate had so happily placed in its hands . . . or tentacles . . . or hoses . . . or whatever.

The deed was done, while Moriarty turned first pale white then a deep crimson — and finally reported the transaction to his machine by spinning a large valve with such force that I felt it must surely fly off the attached pipe. As he consulted his gauges, his face reached a shade that was positively alarming to a medical man

"I fervently hoped Holmes would pass Go without encountering either the Luxury Tax or the rent of the Boardwalk."

such as myself. Finally, he turned slowly to Holmes and smiled through clenched teeth, "Would you like to trade?"

"What is your offer?" asked the detective cooly. But I saw the cords in his neck tighten as he fought to keep from smiling.

The man to whom Holmes referred as "the most dangerous criminal in London" turned once more and opened a valve. Holmes's whole body was now as tight as the strings on his Stradivarius the day he tried to tune it himself; but all eyes were on Moriarty.

Suddenly a rolling boom reached our ears from the direction of Pierce Avenue,

and all eyes, with the exception of Holmes's, turned that way.

I followed his gaze and saw him relax as all the gauges on the Professor's board slammed against their stops with a tinkling of broken glass barely audible above the roar from the west. He then turned his head westward and up to watch a rather large slate roof, some distance away, describe a lazy parabola through the autumn sky.

By the time the roof had dropped out of view, the Professor and his gang were legging it down the avenue at a considerable pace.

Holmes laughed as he got out his pipe. "A good show, eh, what?"

I stood speechless, my bowler in my hand, mentally putting together the pieces of this remarkable stroke of luck.

"Not luck, my dear Watson," he answered my unvoiced thought, as he knocked the dottle from his pipe into my hat. "Well, not entirely; you see, I knew I could not win a fair contest, and Professor Moriarty also realized it. You will recall how quickly he agreed to our safeguards — witness the presence of our constabulary to referee. Indeed, I must credit him with playing a more honest game than I."

I watched as he strolled over to the lamppost nearest the ruined analogue console and detached an inconspicuous hose from the Professor's bundle that had been surreptitiously connected to the fitting where the gas mantle should have been.

"Do you mean to tell me," I blurted, "that all morning the Professor's computer has been filling with explosive gas?"

"I blush to admit it, Watson, but since I had no plan when we arrived this morning other than to play my best possible game, when I saw my chance, I jumped at it.

"I had not anticipated it, but when I saw that the Professor's workmen had conveniently used the lampposts for supports, the strategem of introducing gas into his system immediately occurred to me. Beyond my wildest hopes, the workmen left their machinery unattended for a short period of time, giving me precisely the opportunity I desired.

"You may recall that I diverted your attention briefly this morning, while I stood near the Professor's console. It was all the time I needed to attach a hose and crack open the gas valve. It was then only a matter of waiting for the air and gas mixture to reach the proportion conducive to an explosion and hoping that a spark or friction within the machine would set it off. The outcome you know.

"I perceive by your expression that you disapprove of my little sabotage. Ah well, I am not proud of it myself, for it was quite unsportsmanlike; but I must console myself with the fact that it will be some little time before Professor Moriarty is able to use his computer to further his nefarious career. So, perhaps the great city of London will be the winner as a result of our adventure.

"But come, Watson. The day is still young and these sterling representatives of the British police will clear the playing field and return our money. If you will help me carry this typewriter back to Baker Street, I might be persuaded to create a set of instructions for TESLAVAC that could conceivably help our luck at the racetrack. Perhaps I may yet convince you of the practical value of the computer."

"Yes," I said, watching him smile between the pound sterling signs suddenly floating before my eyes. "Perhaps you may."

THE END ■

ASCII-to-Selectric Software Driver

Selectrics make fine low-budget hard-copy devices—if your micro speaks their language.

Robert E. Munn
6255 Radcliffe Dr.
San Diego CA 92122

Recently, commercial users of letter-quality computer printout devices have accelerated their replacement of older, IBM Selectric-based terminals and printers with newer, high-speed machines having more formatting flexibility. As a result, many of the eight- to ten-year-old Selectric devices are appearing on the surplus-equipment market.

These rugged, medium-speed (140 wpm) machines offer hobbyists an opportunity to acquire a high-quality, uppercase/lowercase printer to use in home applications of word processing. Examples of these uses include writing formal business letters, technical reports, magazine articles, etc. In addition, these printers can be used to generate accurate and reproducible (camera-ready) listings of computer source programs, memory dumps, etc. Most of these terminals also can perform double duty at home as off-line electric typewriters.

Almost all of these machines are designed to be linked with a computer or a modem, using serial RS-232 data interface standards . . . but, here lies the problem. Instead of using the modern standard ASCII 7-bit character code, these terminals generally use one of the older computer-communication codes such as IBM's 6-bit EBCD (extended binary-coded decimal) or 6-bit Correspondence code. Because of the code incompatibility with ASCII, these machines are frequently offered in used, working condition for several hundred dollars less than their ASCII counterparts.

This article describes a "mostly software" ASCII-to-IBM conversion to permit an 8080-based system to drive a data terminal that uses the IBM Correspondence code. This driver produces serial RS-232 data in exactly the format that the terminal needs, so no hardware interface or terminal modifications are required.

Only minor changes are needed to modify this software for use with the 6-bit EBCD code or to change the timing for use with different CPU clock frequencies. As is, the timing supports systems with 2 MHz CPU clocks, such as the Imsai 8080. The hardware required in the computer to support this driver is minimal—one bit of a latching output port and a TTL to RS-232 level interface circuit (more about this later).

The terminal shown in the accompanying photo is representative of many manufactured in the early 1970 period. It is an ITEL model 1051, containing a wide-carriage IBM Selectric mechanism, a paper tape punch and reader and the electronic circuits needed to interface the unit with a computer or modem. The interface uses serial RS-232B data standards at 14.9 characters per second. These machines come equipped with either the IBM 6-bit EBCD, 6-bit BCD or 6-bit Correspondence code.

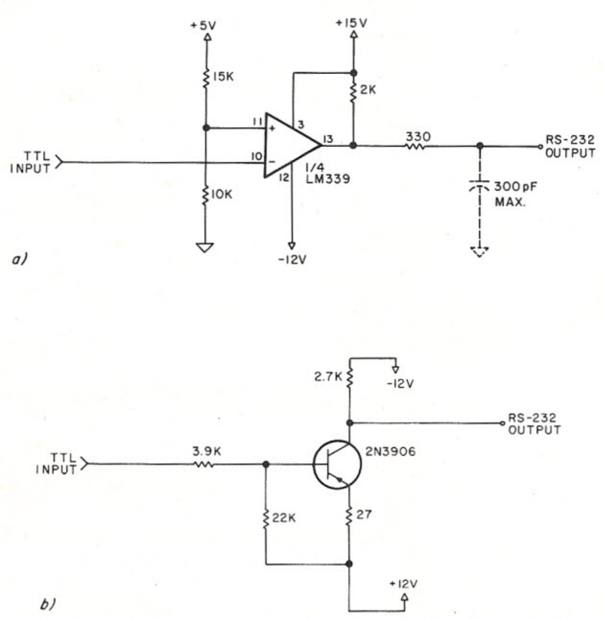


Fig. 1. TTL to RS-232 drivers: a. Circuit using IC (from reference 2); b. Transistor circuit (from reference 3).

The 6-Bit IBM Character Codes

The ASCII character code set represents up to 128 unique printing and nonprinting characters or machine commands due to its 7-bit format (2^7 is 128). The IBM 6-bit codes are limited to representing only 64 unique characters, which is insufficient to handle both uppercase and lowercase letters, all numerials, punctuation and nonprinting command characters.

The designers used an old typewriter-keyboard trick to solve this dilemma. They allowed two sets of 64 characters to share the same transmission codes. One is called uppercase, and the other is lowercase. To change from one set to the other, two codes are reserved for "shift up" or "shift down" operations. When the computer sends a shift up command, all the subsequent characters are printed in uppercase. When shift down is sent, the subsequent characters will be lowercase.

Wait a minute! That sounds just like the way my old Model 15 Teletype works! And so it is . . . only the number of bits is different, six versus five, and the printing speed is 140 wpm instead of 60 wpm. Now since I

had just completed a year of successfully operating my Model 15 with a software ASCII to Baudot conversion, it seemed that the same approach should work with my recently acquired ITEL terminal. I sat down and reworked the Baudot software, wrote a new code conversion table, and within an hour my ITEL was printing . . . gobbledygook!

That is how I discovered my particular terminal was structured in Correspondence code instead of the EBCD code I had assumed. One hour later and all was well. The ITEL was printing both uppercase and lowercase at a blinding 140 wpm speed!

The author's system showing the ITEL Selectric terminal on the right, with display, computer and ASCII keyboard on the left.

What You Need

Hardware needs include an 8080 or Z-80 system with 2 MHz clock, an I/O board with at least one available bit of an 8-bit latching output port and a TTL-to-RS-232 voltage level interface. My Processor Technology 3P + S I/O board required only one jumper to produce the proper RS-232 output to directly drive the ITEL terminal.

A tip to Tarbell cassette interface users: If you are not using the control output port (6E) to start and stop your recorders, then you already own a latching output port capable of driving TTL levels. A circuit for converting TTL to RS-232 levels is shown in Fig. 1.

Memory-space requirements for this ASCII-to-IBM driver involve approximately 340 bytes including the code conversion table. All this can be put in ROM, except for a stack area of 24 bytes and one byte for the case flag, which must be in RAM memory. If you use 1702A EPROMs or other slower-access types that require additional wait cycles during readout, you will have to change the software timing loop constants to compensate for the different speed. Similar compensation will be required if your CPU clock is other than 2 MHz.

What It Does

The driver program is designed for output (printing) only. It does not decode the ITEL keyboard to allow input to the computer. I made this decision because the ITEL terminal operates in "half-duplex" only, which means it cannot simultaneously transmit and receive. I felt that the complexity of merging this type of operation with my existing computer software (BASIC, editor/assembler, etc.) was too great, so I used a separate keyboard as input for my microcomputer.

The driver software performs the following functions. When the computer is ready to send out a character to be printed, your computer program (BASIC, editor, word processor) must put the ASCII character in the accumulator and then CALL the starting address of the driver subroutine. The subroutine then performs the required code conversion and sends a properly formatted serial RS-232 output word to your terminal, via the latching parallel output port of your I/O board. When the character has been sent, the driver subroutine RETURNs control to the calling program. During this process the following functions are performed:

1. On being called, the subroutine saves all registers and flags from the calling program, does the conversion and restores them upon return from the call.

2. The new character is checked to see if it is the same case (upper/lower) as the previous character sent. If not, printing is delayed until a proper SHIFT UP or SHIFT DOWN character is sent to the terminal.

3. The ASCII character is then checked against a lookup table in which the LSB of the table address is the ASCII code and the data stored at each location represents the corresponding IBM code, configured with two additional bits representing parity and case.

4. When the proper IBM code has been located, it is applied to a software serial output routine, which causes it to be sent out via the latching output port, one bit at a time. The output word consists of a start bit, six data bits, a parity bit and a stop bit. These bits are timed in a software loop to provide 7.43 milliseconds per bit, or 14.9 characters per second.

5. A check is made to see if the outgoing character is a carriage return. If so, it is followed by a long delay to permit the type ball to return to the left margin before printing resumes. This is one situation in which the IBM mechanism is much slower than the older Teletype printers.

6. A check is also made to see if the outgoing character is a space, a period or a delete (blank). These character codes are duplicated in both uppercase and lowercase sets, and the subroutine prevents sending needless SHIFT commands, which might otherwise be required.

The Code Conversion Table

As mentioned earlier, the IBM code data for each printing symbol or machine operation is placed in the table at an address (LSB) corresponding to the ASCII code. The lookup table (Table 1) has been configured for all uppercase and lowercase letters, all numerals and most of the ASCII-IBM common punctuation. When an equivalent printing symbol did not exist, I either substituted symbols or placed a (7FH) delete in the table. The substitutes are # (less than), & (gtr. than) and % (up arrow). The alternative to this is to find an IBM type ball with all the desired characters . . . good luck! The delete code causes the terminal to ignore the incoming characters.

Table 1 includes the IBM 6-bit

ADDRESS-HEX	ASCII CHAR	CORR	BCD	EBCD
3800	NUL	7F	7F	7F
01		7F	7F	7F
02		7F	7F	7F
03		7F	7F	7F
04		7F	7F	7F
05		7F	7F	7F
06		7F	7F	7F
07	BEL	7F	7F	7F
08	BKSP	7F	7F	7F
09	TAB	2F	2F	2F
0A	LF	7F	7F	7F
0B	VT	7F	7F	7F
0C	FF	7F	7F	7F
0D	CAR.RET.	6D	6D	6D
0E	SO	7F	7F	7F
0F	SI	7F	7F	7F
3810		7F	7F	7F
11		7F	7F	7F
12		7F	7F	7F
13		7F	7F	7F
14		7F	7F	7F
15		7F	7F	7F
16		7F	7F	7F
17		7F	7F	7F
18		7F	7F	7F
19		7F	7F	7F
1A		7F	7F	7F
1B		7F	7F	7F
1C		7F	7F	7F
1D		7F	7F	7F
1E		7F	7F	7F
1F		7F	7F	7F
3820	SP	40	40	40
21	!	81	75	75
22	"	49	38	34
23	#	70	B4	B4
24	$	04	F5	F5
25	%	08	68	68
26	&	68	C3	C3
27	'	C9	58	58
28	(	34	64	64
29	)	64	54	54
2A	*	38	04	04
2B	+	13	34	43
2C	,	3B	F6	F6
2D	-	B7	81	81
2E	.	51	B7	B7
2F	/	87	E2	E2
3830	0	E4	D4	D4
31	1	C6	A0	A0
32	2	90	90	90
33	3	F0	F0	F0
34	4	84	88	88
35	5	88	E8	E8
36	6	D8	D8	D8
37	7	E8	B8	B8
38	8	B8	84	84
39	9	B4	E4	E4
3A	:	6B	08	08
3B	;	EB	70	70
3C	< (#)	70(2)	B4(2)	10
3D	=	93	20	20
3E	> (&)	68(2)	C3(2)	38
3F	?	07	62	62
3840	¶	10	82	82
41	A	79	23	ALL LTRS
42	B	76	13	SAME AS
43	C	7A	73	BCD.
44	D	2A	0B	

ADDRESS-HEX	ASCII CHAR	CORR	BCD	EBCD
45	E	4A	6B	
46	F	73	5B	
47	G	23	3B	
48	H	26	07	
49	I	19	67	
4A	J	43	61	
4B	K	1A	51	
4C	L	46	31	
4D	M	61	49	
4E	N	52	29	
4F	O	45	19	
3850	P	0B	79	
51	Q	5B	45	
52	R	29	25	
53	S	25	52	
54	T	02	32	
55	U	32	4A	
56	V	31	2A	
57	W	75	1A	
58	X	62	7A	
599	Y	67	46	
5A	Z	54	26	
5B		7F	7F	7F
5C		7F	7F	7F
5D		7F	7F	7F
5E	↑ (%)	08(2)	68 (2)	68 (2)
5F		7F	7F	7F
3860		7F	7F	7F
61	a	F9	A3	ALL LTRS
62	b	F6	93	SAME AS
63	c	FA	F3	BCD.
64	d	AA	8B	
65	e	CA	EB	
66	f	F3	DB	
67	g	A3	BB	
68	h	A6	87	
69	i	99	E7	
6A	j	C3	E1	
6B	k	9A	D1	
6C	l	C6	B1	
6D	m	E1	C9	
6E	n	D2	A9	
6F	o	C5	99	
3870	p	8B	F9	
71	q	DB	C5	
72	r	A9	A5	
73	s	A5	D2	
74	t	82	B2	
75	u	B2	CA	
76	v	B1	AA	
77	w	F5	9A	
78	x	E2	FA	
79	y	E7	C6	
7A	z	D4	A6	
	PUNCH ON	4C	4C	4C
	READER START	2C	ALL CODES SAME	
	SHIFT UP	9C	AS CORR. FOR	
	EOT	FC	THESE FCTNS.	
	FIELD CNTRL	16		
	PRINT OFF	0E		
	SKIP OFF	3E		
	PRINT ON	0D		
	BKSPACE	5D		
	READER STOP	3D		
	PUNCH OFF	4F		
	H TAB	2F		
	SHIFT DOWN	1F		
	DELETE	7F		
	LINEFEED	6E		
	CAR.RET.+LF	6D		

Table 1. ASCII to IBM code conversion. Use the appropriate code set for your terminal. Note 1: 7F DELETE code is substituted where terminal does not support symbol or when I wished to delete the function. Note 2: substitute code used because type ball did not have appropriate symbol.

BCD, EBCD and the Correspondence code used in my version of the ITEL terminal. Codes are also shown for various machine functions, PUNCH ON/OFF, READER START/STOP, etc., for which no ASCII values exist. You may wish to change the lookup table to suit your particular needs.

Beware: The values in my table do not agree with those shown in the usual IBM-ASCII equivalence tables. This is because my serial output subroutine forms its output word by shifting the lookup code, one bit at a time, to the right. My table had to be arranged with the bit pattern in reverse order, compared to the table in the ITEL manual. Also, the leftmost bit in the table is the case-bit, with a 1 in this position indicating lowercase. This bit is used by the driver program, but is not transmitted to the terminal. The order of bits in my table is C P 1 2 4 8 A B. This is represented in Table 1 in hexadecimal format.

As an example, the uppercase letter A is shown in the ITEL manual as having a hex code of 27 for the normal IBM Correspondence code sequence of B A 8 4 2 1. The 6-bit binary pattern would be 1 0 0 1 1. To convert this to my table format, add C = 0 for uppercase, P = 1 to make an odd number of 1s (odd parity). Rearrange the bits into my table format of C P 1 2 4 8 A B, and we get a binary pattern of 0 1 1 1 1 0 0 1, or 79H. This data is stored in the lookup table at location 3841H, where the LSB (41H) equals the ASCII value for uppercase A.

One special note about Table 1: The code for line feed (6EH), which would normally appear at ASCII location 0AH, has been replaced by a delete. This is because the ITEL terminal automatically performs a line feed after every carriage return. I found that my BASIC interpreter, my editor/assembler and other packaged software were sending both a carriage return and a line feed to the printer, causing two vertical spaces to occur instead of one. I also substituted the code for lowercase l in the ASCII location for numeral one to avoid printing a strange bracket sym-

bol in place of the numeral. All this points to the advantages of a software conversion scheme, where you can tailor the lookup table to your own system needs.

The Program

Since the source listing in Listing 1 includes comments, I will only give a brief description of each portion. The OUT1 segment includes the routines to save and restore all registers and flags. The IBM segment begins the code conversion by recovering the case flag for the previous character from its RAM location and sets the H and L registers to the starting address of the lookup table. The COMPR segment compares the ASCII character with the LSB of the lookup address. If they don't match, H and L are incremented by one, and the comparison is repeated until a match is established, or until the last address in the table is reached. When the ASCII match is obtained, the program jumps to OUT3. In this segment the IBM code is moved from memory into the accumulator and also saved in the L register.

Tests are then made to see if the character is a space, a period or a delete. For these special cases the remainder of OUT3 is bypassed, and the program jumps to OUT4. For all other characters, a test is made to see if the new character is the same case as the previous character. This is done by comparing only the most significant bit of the IBM code with the case flag bit in the E register. If they are identical, the program passes to OUT4, but if they differ it jumps to MODFY.

Assuming MODFY is required, the case bit is again tested to see if the new character is lowercase or uppercase. The program then jumps to either UPPER or LOWER, where the appropriate SHIFT code is put into the accumulator and OUT5 is called. This causes the SHIFT character to output as a serial code to the terminal. On return from the call, the program jumps to OUT4 to prepare for sending the new character.

In OUT4, the case bit is masked off (no longer needed),

```
3700                *SELECTRIC VERSION 13 DEC 78
3700                *ASCII TO IBM CORR CODE
3700                *CALL WITH ASCII CHAR.
3700                *IN "A" REGISTER.
3700 22 B1 37       OUT1   SHLD  STK+3          SAVE ALL REGISTERS
3703 21 00 00              LXI   H,0
3706 39                    DAD   SP
3707 31 C6 37              LXI   SP,  STK+18H
370A E5                    PUSH  H
370B D5                    PUSH  D
370C C5                    PUSH  B
370D F5                    PUSH  PSW
370E CD 1C 37              CALL  IBM  ;       CONVERT AND PRINT
3711 00                    NOP
3712 00                    NOP
3713 F1                    POP   PSW  ;       RESTORE ALL REG.
3714 C1                    POP   B
3715 D1                    POP   D
3716 E1                    POP   H
3717 F9                    SPHL
3718 2A B1 37              LHLD  STK+3
371B C9                    RET                  RET. FROM CALL
371C 21 FF 38       IBM    LXI   H,CASE         START CONVERSION
371F 5E                    MOV   E,M  ;       CASE FLAG IN E
3720 21 00 38              LXI   H,TABL         SET TO START OF TABLE
3723 E6 7F                 ANI   7FH  ;       MASK ASCII PARITY
3725 BD             COMPR  CMP   L  ;       CHAR = ADDRESS ?
3726 CA 33 37              JZ    OUT3           YES THEN JUMP OUT3
3729 47                    MOV   B,A
372A 3E 7B                 MVI   A,7BH          TABLE END ADDRESS
372C BD                    CMP   L  ;       TABLE END?
372D C8                    RZ                   ;FAILED TO CONVERT
372E 78                    MOV   A,B
372F 23                    INX   H  ;       NXT TABL ADDR
3730 C3 25 37              JMP   COMPR
3733 7E             OUT3   MOV   A,M  ;       IBM CHAR IN A
3734 6F                    MOV   L,A  ;       SAVE IN L
3735 FE 40                 CPI   40H  IS IT SPACE?
3737 CA 4A 37              JZ    OUT4           YES BYPASS MODFY
373A FE 51                 CPI   51H  IS IT PERIOD?
373C CA 4A 37              JZ    OUT4           YES BYPASS MODFY
373F FE 7F                 CPI   7FH  IS IT DELETE?
3741 CA 4A 37              JZ    OUT4           YES BYPASS MODFY
3744 E6 80                 ANI   80H  ;       MASK CASE FLAG
3746 BB                    CMP   E  ;       CASE=LAST?
3747 C2 5B 37              JNZ   MODFY
374A 7D             OUT4   MOV   A,L  ;       OUTPUT IBM CHAR
374B E6 7F                 ANI   7FH  ;       MASK CASE FLAG
374D CD 76 37              CALL  OUT5           GOTO SOFTWARE SERIALIZER
3750 7B                    MOV   A,E  ;       SAVE NEW CASE FLAG
3751 32 FF 38              STA   CASE
3754 7D                    MOV   A,L  ;       GET CHAR IN A
3755 FE 6D                 CPI   6DH  IS IT CAR. RET?
3757 CC A4 37              CZ    DLY2           YES LONG DELAY
375A C9                    RET                  FROM CALL TO IBM
375B FE 80          MODFY  CPI   80H  IS IT LOWER CASE?
375D C2 6B 37              JNZ   UPPER
3760 1E 80          LOWER  MVI   E,80H
3762 3E 1F                 MVI   A,1FH          SEND SHIFT DOWN
3764 CD 76 37              CALL  OUT5
3767 C3 4A 37              JMP   OUT4           THEN SEND CHAR.
376A 00                    NOP
376B 1E 00          UPPER  MVI   E,0
376D 3E 9C                 MVI   A,9CH          SEND SHIFT UP
376F CD 76 37              CALL  OUT5
3772 C3 4A 37              JMP   OUT4           THEN SEND CHAR.
3775 00                    NOP
3776 00             OUT5   NOP                  SERIAL OUTPUT ROUTINE
3777 06 07                 MVI   B,7  ;       DATA BIT COUNT
3779 07                    RLC
377A 4F                    MOV   C,A  ;       SAVE SHIFTED CHAR
377B 97                    SUB   A  ;       MAKE START BIT=0
377C D3 00                 OUT   CASP           AND SEND IT
377E CD 97 37              CALL  DLY1           START PULSE TIME
3781 79             LOOP3  MOV   A,C  RECOVER REMAINING BITS IN A
3782 0F                    RRC                  SHIFT RT ONE BIT
3783 4F                    MOV   C,A  SAVE REMAINING BITS IN C
3784 E6 01                 ANI   1  ;       MASK BIT 0 ONLY
3786 D3 00                 OUT   CASP           AND SEND IT
3788 CD 97 37              CALL  DLY1           DATA PULSE TIME
378B 05                    DCR   B  ;       DECR BIT COUNTER
378C C2 81 37              JNZ   LOOP3          ;RPT FOR 7 BITS
378F 3E 01                 MVI   A,1  ;       STOP BIT=1
3791 D3 00                 OUT   CASP           AND SEND IT
3793 CD 97 37              CALL  DLY1           STOP PULSE TIME
3796 C9                    RET                  SERIAL OUTPUT COMPLETED
3797 16 99          DLY1   MVI   D,99H          BIT TIME
3799 3E 05          TMOUT  MVI   A,05H
379B 3D             LOOP4  DCR   A
379C C2 9B 37              JNZ   LOOP4
379F 15                    DCR   D
37A0 C2 99 37              JNZ   TMOUT
37A3 C9                    RET
37A4 26 55          DLY2   MVI   H,85D          C.R. DELAY
37A6 CD 97 37       LOOP5  CALL  DLY1
37A9 25                    DCR   H
37AA C2 A6 37              JNZ   LOOP5


37AD C9                    RET
37AE                STK    DS    20H
37CE                CASE   EQU   38FFH          CASE FLAG
37CE                CASP   EQU   00H  LATCHING OUTPUT PORT
37CE                TABL   EQU   3800H
37CE                END    EQU   END

SYMBOL TABLE

CASE   38FF   CASP   0000   COMPR 3725   DLY1   3797   DLY2   37A4
END    37CE   IBM    371C   LOOP3 3781   LOOP4  379B   LOOP5  37A6
LOWER  3760   MODFY  375B   OUT1  3700   OUT3   3733   OUT4   374A
OUT5   3776   STK    37AE   TABL  3800   TMOUT  3799   UPPER  376B
```

Listing 1. Source listing.

```
ADDRESS        DATA (HEX)        INSTR             COMMENT
**************************************************************
3600           31 2F 36          LXI SP,362FH      SET SP
3603           3E 00             MVI A,0
3605           32 FF 38          STA 38FFH         INITLZ CASE BIT
3608           DB 00             IN 0              GET KBD STATUS
360A           E6 01             ANI 01H
360C           C2 08 36          JNZ 3608H         WAIT FOR CHAR.
360F           DB 01             IN 1              GET CHAR IN A
3611           E6 7F             ANI 7FH           MASK PARITY
3613           CD 00 37          CALL IBM          PRINT IT
3616           C3 08 36          JMP 3608H         GET NEXT CHAR.
**************************************************************
```

Listing 2. Test routine to echo your keyboard inputs on the Selectric printer.

```
ADDRESS        ORIGINAL                  CHANGE TO
               VERSION
**************************************************************
011F           DB    IN STATUS           78    MOV A,B
0120           00                        CD    CALL IBM
0121           E6    ANI 80H             00
0122           80                        37
0123           C2    JNZ 011FH           00    NOP
0124           1F                        00    NOP
0125           01                        00    NOP
0126           78    MOV A,B             00    NOP
0127           D3    OUT DATA            00    NOP
0128           01                        00    NOP
0129           C9    RET                 C9    RET
**************************************************************
```

Listing 3. Modifications required to typical 8080 output routine in order to link with the Selectric Driver program. From "ESP-1 Editor-Assembler" by Michael Shrayer Software, Inc.

```
ADDRESS        DATA (HEX)        INSTR             COMMENT
**************************************************************
0000           3E 39             MVI A,"9"         GET ASCII 9
0002           CD 00 37          CALL IBM          ENABLE TERMINAL
0005           C3 00 F0          JMP MONITOR       BACK TO SYSTEM
**************************************************************
```

Listing 4. Simple start-up program to send EOA to Correspondence terminals. See text for changes required for BCD and EBCD users. When finished, this program jumps back to my system monitor program address F000H.

and OUT5 is called to send out the six data bits plus one parity bit. After the new character has been sent, OUT4 causes the new case flag to be stored in RAM. It also tests to see if the new character (already sent) was a carriage return. If so, OUT4 calls DLY2, a long delay timer to allow time for the type ball to return before resuming printing. When OUT4 is completed, the program returns from the call to IBM, that is, it returns to the concluding portion of OUT1 and then returns to the calling program.

The serial output routine OUT5 initially sets up the number of data bits to be transmitted (seven, including parity). It then causes a START bit to be sent out for a duration set by DLY1. The six data bits plus the parity bit are then sent to the output port in succession by being shifted to the right, one bit at a time. Only the rightmost bit is masked through and output to the port. After the parity bit is sent, OUT5 concludes the output word by sending a STOP bit.

The DLY1 subroutine is used to create the 7.43 millisecond period of each bit in the transmitted word. It involves a timing loop LOOP4 nested within a second loop TMOUT. The initial values for registers D (99H) and A (05H) are based upon a 2 MHz CPU clock and RAM memory access with zero wait cycles. These must be changed if you have a different clock frequency or slower memory access time. The DLY2 timing subroutine produces the long delay required after a carriage return has been sent.

In the source listing, the RAM location of the case flag is set at location 38FFH; the ASCII-IBM lookup table begins at 3800H; and the driver program itself is assembled beginning at 3700H. A RAM stack area from address 37AEH to 37CEH is used by the driver.

Testing and Using the Driver

Listing 2 shows a simple test routine I used to verify that the driver program would take ASCII inputs from my computer keyboard and cause the ITEL printer to type the required output. Listing 3 shows a typical modified output routine for use with packaged computer software. In this case it is from the "ESP-1 Editor/Assembler," produced by Michael Shrayer Software, Inc. In this software, and many other packaged programs, the ASCII character is in the B register instead of the accumulator at the beginning of the original output routine. In order to properly link such software with the driver program, you must start with a MOV A,B instruction, then call the driver.

RS-232B Connections

Fig. 2 shows the connections between my I/O board and ITEL terminal. The connector that plugs into the terminal is a DB-25P and is wired according to the RS-232 pin assignments. For our purposes we must be concerned with serial data going to the terminal (pin 3) and with certain control signals required to make the terminal work. To enable my terminal in the "receive" mode, I found it necessary to wire pins 6 and 8 high by connecting them to +5 volts via individual 620 Ohm resistors. This simulates the "data set ready" and "data carrier received" signals.

Turn-on Protocol

Because this terminal operated in a half-duplex mode only, certain character codes were used to indicate that it should switch from receive to transmit mode or vice versa. In my terminal, the first character sent after power-on must be an EOA code (B4H) identical to numeral 9. This character does not print but causes the "receive" lamp on the ITEL to come on, indicating it is ready to print any subsequent characters. The terminal will stay in the receive mode as long as the power stays on, or until an EOT code (FCH) arrives.

This will never happen, since I have not included that code in the lookup table. To provide the initial EOA command, you can either use your keyboard and the Test Input program in Listing 2 or simulate the typing of a 9 with the simple program shown in Listing 4.

Differences for Owners of BCD and EBCD Terminals

Besides a different lookup table, there are several minor changes you will have to make in the driver program if your terminal uses the 6-bit BCD or EBCD codes. In EBCD the period only appears in the lowercase character set, so you will have to delete (change to NOPs) the CPI and JZ instructions in OUT3 that apply to the period. BCD owners will have to change the argument of the same CPI instruction to (B7H).

In both BCD and EBCD the EOA character code needed to enable the terminal represents the lowercase # symbol instead of the numeral 9. Therefore, the program in Listing 4 will be changed to start with MVI A, #, or in object code, 3E 23.

The Paper Tape Punch and Reader

What can I say? They work fine with the terminal and are useful without the computer in typing repeat business letters. Unfortunately, they are hard-

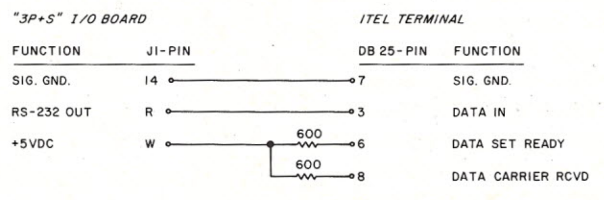


Fig. 2. Cable connections I use to drive the ITEL terminal. On the 3P+S board I jumpered pad 4 (EIA4) to row 2 (bit 0) in area J. This assigned the RS-232 output to bit 0 of latching output port 0.

wired to read and generate only the 6-bit plus parity code format. Without internal rewiring, it is impossible to use them to punch or read ASCII 7-bit tapes. The parity bit is an obstacle that has so far defeated me. Perhaps this problem will provide fodder for another article in the future.

Mechanical Maintenance

As wonderful and rugged as these terminals are, they cannot be expected to work forever without proper cleaning, lubrication and adjustment. If you feel capable, you should obtain a repair manual for your terminal and set up a periodic maintenance schedule. If you live in an area where many businesses use Selectric-type office machines or terminals, you should be able to locate a repair service company to do maintenance and repairs on your machine.

Conclusions

Well, there you have it. I have had fully satisfactory performance from this driver program and watched it drive the ITEL terminal for disassembly listings that lasted over three solid hours! It never missed a character. I have particularly appreciated the ability to link this driver to a word processor and produce neat, legible and professional-appearing letters. It goes without saying that the manuscript for this article was typed using this system.

In closing, I wish to acknowledge the help I received from Holland M. Smith in writing this driver program and the authors of reference 1 for the serial-output concept, which has proven so successful.■

References

1. "A Very Cheap I/O—The Model 15," Whipple and Arnold, *73 Magazine*, May 1976, p. 77.
2. "Who's Afraid of RS-232?" Pickles, *Kilobaud*, May 1977, p. 50.
3. "A Low Cost Modem," Holley, reprinted in San Diego Computer Society's *Personal Systems Magazine*, Nov./Dec. 1978, p. 14.

Introduction to the TMS-9900

Texas Instruments' TMS-9900 has been around for a while but has been ignored, the author feels, by hobbyists. In this article, he sheds light on the capabilities of the 9900.

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Although the TMS-9900 has been on the market for some time now, there seems to be widespread ignorance of its capabilities among hobbyists. This is a shame because it is one of the most versatile microprocessors. Therefore, I have set out to fill this information gap. Without going into too much detail, here is a description of the major features of the 9900 family.

Word Length

Ask any hobbyist what he knows about the 9900 and he will tell you, "Oh, yeah, that's one of those 16 bit micros." True, the 9900 family employs a 16 bit word length. The 9980, however, uses an external 8 bit data bus, allowing it to be easily interfaced to 8 bit devices. A CPU board is available for the S-100 bus, which uses the TMS9900JL, the 16 bit version.

How does it communicate with the 8 bit bus? When it wants 16 bits of data, it pulls SXTRQ (Sixteen Request) low. If there is no response on SXTNACK (Sixteen Acknowledge), it assumes an 8 bit device and multiplexes the data. Thus, the hardware interface is really no problem. Furthermore, all calculations may be done on units of either 8 or 16 bits, giving great flexibility in computation.

The TMS9900JL uses a 15 bit address bus with a "pretend" 16th address bit. The pretend bit is used for byte operations and is an actual address bit on the 9980. Addresses are given in hexadecimal, regardless, and always include this bit, even though it is always 0 for the 9900. Therefore, they are all even numbers in the range 0-FFFE.

For this reason, a 2048 word section of memory (4096 bytes) occupies a memory slot such as X000-XFFE. The maximum memory space is 32,768 words. Just for laughs, TI numbers the bits Data General-style, with bit 0 being the most significant bit and bit 15 the least significant bit.

Registers

The 9900 has only three on-chip registers: the WP (Workspace Pointer), the PC (Program Counter) and the ST (Status Register). There are no general-purpose registers on the CPU chip itself. All registers are implemented in memory at the location pointed to by the Workspace Pointer plus an offset given by the register number doubled (because of the pretend bit).

This may seem strange, but observe that, by changing the Workspace Pointer, we can get a whole new set of registers. This is, in fact, done during some operations, as we shall see.

Instruction Set

Yes, the 9900 has hardware multiply and divide. The only restriction on these instructions (which use unsigned operands) is that the destination must be a workspace register.

Just about all of the remaining instructions may manipulate registers or memory using absolute, indirect, indirect with auto-increment or indexed addressing. (Auto-increment means that after you fetch or store the data at the location pointed to by a register, the register is incremented.) Sixteen different software interrupts are provided. Most of the standard arithmetic and logical operations are provided. There is a large variety of one-word conditional jumps, program relative. Branch instructions and subroutine calls can use any of the above addressing modes. Curiously, there is no AND instruction.

Subroutine Calls

Many times it has been suggested that hardware be employed to convert the 9900 to work with a stack, similar to the 6800 and other microprocessors. These suggestions stem from a misunderstanding of the 9900's elegant data structuring.

Remember that the 9900's registers are in memory at the location pointed to by WP. There are two types of subroutine calls on the 9900: BL (Branch and Link), where the program counter is stored in R11 and the WP is unchanged, and BLWP (Branch and Load Workspace Pointer), where the WP and PC are loaded from the address of the argument, and the old WP,PC and ST are stored in the new R13, R14 and R15, respectively.

Thus, the BLWP jumps to a new location and gives us a new set of registers, without damaging the old registers in any way. If you need any of the old registers, you can access them by using indirect addressing with R13. You can set any status bit upon return by manipulation of R15. You can even skip code upon return by modifying R14 (although I don't recommend it).

When the RTWP instruction is encountered, WP, PC and ST

are reloaded from R13, R14 and R15, and execution resumes. A little thought will show you that this process is simpler, therefore faster, yet superior to any stack system with its attendant pushes and pops. And the BL instruction is always there in case you want to use the same registers. The 9900 technique is simple, fast and flexible.

I/O

Rather than address I/O devices in memory, they are placed in a "CRU address space" containing 4096 locations, each of which is one bit. Data exchanges are synchronous bit-serial: Data is clocked out of the CPU, or into it, one bit at a time. Each I/O bit is individually addressable. This is especially convenient for a lot of applications where N-bit operations must take place and N is not equal to 16. It is also possible to test bits of I/O or turn them off or on without modifying any registers.

There are a number of complications, however. The CRU address appears over bits 3 to 14 of the address bus, ignoring the pretend bit. Thus, there are two possible ways of expressing the CRU address: right-justified and as the actual address on the bus. You guessed it! TI uses both!

The first they call the CRU address. It is required when the Microterminal is used. The second they call the R12 address. It is required when a Teletype with the T-BUG operating system is used. It is called the R12 adress because all I/O transfers are made indirectly via the address in R12.

If the two possible methods of expressing the address were not confusing enough, TI has further complicated matters by unnecessarily using four hexadecimal digits for the CRU address where only three would suffice.

Furthermore, when multi-bit data is sent to a CRU port, the bit significance is numerically reversed, i.e., bit 15 (least significant bit) goes to CRU address (R12) + 0, bit 14 to (R12) + 2, etc. If you send out 16 bits, bit 0 will end up on PB15 of a 9901 parallel port. These bits arrive sequentially at CRU clock rate, too, raising the possibility of hardware glitches. And, if eight or fewer bits are involved, the most significant byte (upper eight bits) will be used rather than the least significant bit.

Although this technique is unnecessarily complicated and confusing, it has a great many advantages. (Believe it or not!) CRU exchanges may take place using registers of memory. You can use any addressing mode. CRU exchanges using auto-increment make for fast and compact I/O routines. The nondestructive bit tests and changes are a great help, too.

My feeling is that if you stick to the R12 address and ignore the CRU address, you can avoid confusion and reap the benefits.

Summary

The 9900 seems quite confusing at first, especially if you read TI literature. However, programs for the 3 MHz 9900 run about twice as fast as their 6800 or Z-80 counterparts, and are usually one-third to one-half as long. Besides, TI recently announced the 4 MHz version, priced at $41.25.

TI is now starting to make available personal computers using these products, such as a notebook-sized 9980 system similar to a KIM-1. The new 99/4 personal computer at $1150 is actually quite reasonable, considering that it comes with 16K of RAM and a large color monitor.

These products are expensive, but not as much so as the LSI-11 series. Also remember that TI has committed themselves to family compatibility of all 9900 products, so you can expand your system at any time. They have undertaken to make PASCAL their standard language, and already have a compiler and an extensive program library available. And they have the nationwide marketing and production facilities to make it work.

If you're thinking of buying a system, consider the 9900. It may be your best solution. ■

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Have a Ball with Bally

When a leading maker of pinball machines turns its attention to microcomputers, the result is a very unusual machine.

The Bally Manufacturing Corporation, producer of the Bally Professional Arcade, began making delivery of their much-awaited plug-in ROM Bally BASIC in autumn, 1978. As many of you already know, the Bally Arcade is a TV video game with a Z-80-based microprocessor unit utilizing plug-in cartridges for instant game changes. Included with the base unit are two multifunction remote hand controllers, each with an 8-position joystick, a trigger and a rheostat-type knob for analog input.

The Arcade attaches to any TV set, preferably color, through a TV/game switch box. A slide switch on the side of the main console permits use of either channel 3 or 4. The main on-off switch is located rather inconveniently on the back of the set alongside the four hand-controller sockets, the audio tape interface socket and the future expansion bus.

A 24-key calculator with ten memory registers is built into the front deck. This keypad is used to select the built-in games, perform typical five-function calculations and enter programs with the Bally BASIC. Remote game selection is also obtained with the No. 1 controller.

Adjacent to the keypad is the cartridge slot where the preprogrammed games or the BASIC ROM is inserted. Your extra cartridges or recorded BASIC program cassettes can be stored in the clear plastic-covered 12-slot holder located on the top of the Arcade. A nondetachable ac power adapter provides the power to the Arcade. It works, but I can't help thinking of similar types of adapters that have quickly failed.

The console is constructed of wood-grained plastic, so the usual precautions to prevent excessive heat and sunlight should be observed. The built-in games and the optional game cartridges are colorful, imaginative and downright fun. However, the real reason I bought the Arcade was the exciting prospect of programming my own audio-video games.

Bally BASIC is a version of Palo Alto Tiny BASIC and was written by Jay Fenton. In addition to the normal Tiny BASIC commands, Bally has included commands to control graphics, color, sound and also to address each function of the pistol-grip hand controls.

Once the ROM cartridge is inserted and the reset button depressed, you are able to enter your own program of up to 1800 bytes via the console's 24-key calculator keyboard. Four different shift keys expand the 24-key layout to provide access to 103 separate letters, numbers, punctuations, operators and commands (see Table 1). A plastic color-coded keypad overlay allows input of three separate kinds of information: numbers, alphanumerics and command words (see Fig. 1).

Numbers and operators are

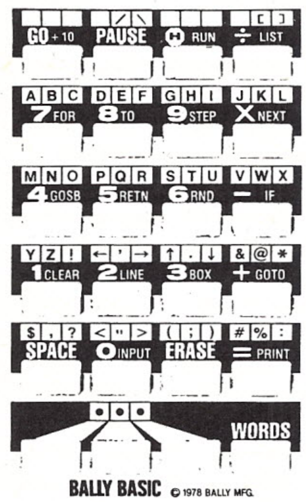

Fig. 1. Bally's 24-key calculator keyboard.

Commands		Standard Statements		Special-Purpose Statements	
Reset	Pause	For	Return	Clear	SZ
Run	Halt	To	Random	Line	TV
List	Go	Step	If	Box	KP
Erase	Stop	Next	Goto	FC	Print #A
		Gosub	Input	BC	KN ( )
		. (period)	Print	MU	TR ( )
				NT	JX ( )
				CX	JY ( )
				CY	PX (X,Y)

String Function – @ ( )
Operators – +, −, ×, ÷, <, >, #
Note: You must use the × and ÷ for arithmetical calculators, not * and /.
Punctuation – The . (period) is equivalent to a remark. The ; (semicolon) permits multiple statement lines. If a semicolon follows an IF statement and the IF condition is false, nothing after the semicolon will be performed.

```
90  B = 2 × A
100 If B = 30 Print "GOOD"; GOTO 20
110 GOTO 30
```

Therefore, if B ≠ 30 the program will go to statement 30, not 20. IF statements can be set up as multiple conditions, i.e., IFA = 3IFB = 4GOTO20 means that only if A = 3 *and* B = 4 will the program go to statement 20.

Table 1.

accessed directly by depressing the appropriate keys. Letters, punctuation, symbols, etc., are accessed by first depressing one of the three colored (green, red, blue) shift keys and then the key under the desired letter. A fourth shift key is colored gold and permits you to enter an entire command word such as PRINT, GOTO, LINE, etc., in a similar fashion. When a colored shift key is depressed, the TV screen displays the corresponding color.

Initially, it is all very confusing, but, surprisingly, becomes second nature after a couple of hours. Unfortunately, the keypad does not have a distinctive click to indicate key depression, but Bally was nice enough to include musical tones to indicate contact completion. These tones can be deleted if desired.

Color Graphics

256 colors are accessible to you, but only two are permitted on the screen at one time. These are selected by the variables BC (background color) and FC (foreground color).

Screen resolution is 159 points wide and 87 points high, with each point capable of being individually addressed. Coordinate point 0,0 is in the center of the screen. Line X,Y,Z draws a line from the end of the last line (or from 0,0 if no line has been drawn) to the coordinates X,Y. Z designates whether the line is to be drawn in the foreground color, the background color, a reverse color . . . or no line at all (Z = 1,2,3 or 4). Box X,Y,A,B,Z places a box of A width and B height with its center at coordinates X,Y. Z permits the same color designation as the Z in LINE. A single point is plotted at X,Y coordinates with this command by setting A and B equal to 1. PX (X,Y) is used to determine the color (background or foreground) of a particular screen coordinate.

Hand Controllers

KN (A) produces a number between −128 and +127, depending on the position of the A hand-controller rheostat knob.

The Bally Computer System, Model ABA-1000.

```
10 Clear; CY=16; NT=1
20 Print "        Battlestar"
30 Print "        Galactica!"; Print
40 Print "              Oct 1978"
50 Print "       By R.J.Nitto"
60 For T=1 to 1000; Next T; R=1; NT=1
70 For C=1 to 9; S=3; If R<1 R=1
80 Clear; BC=248; FC=7                          /Blue background - white foreground.
90 For T=1 to 100; X=Rnd(159)-80
100 Y=Rnd(88)-44; Box X,Y,1,1,1; Next T          /Plot starry background.
110 Print "    Ceylon Warship #",#2,C
120 X=Rnd(50)-25; Y=Rnd(30)-15
130 CY=-40; Gosub R x 10 +330
140 Line -10,-10,0; Box H,V,31,6,2
150 Box X,Y,19,3,1; Box X,Y,31,1,1
160 Box X,Y+1,7,6,1; Box X+7,Y,1,1,1             /Plot target.
170 Box X-7,Y,1,1,1; Line 10,10,1
180 Line 10,-10,0; Line -10,10,1; H=X; V=Y       /Crosshairs
190 If TR(1)=1 S=S-1; G=0; Goto 230              /Did we shoot?
200 If X=0 If Y=0 Gosub 440; Goto 330            /If not & target is centered, we're dead.
210 X=X+Rnd(5)-3; Y=Y+Rnd(5)-3                   /If not,target moves again.
220 X=X-2 x JX(1); Y=Y-2 x JY(1); Goto 140       /Attempt to bring target into crosshairs.
230 For Z=1 to 6; Line -75,-40,0; MU=80
240 Line 0,0,3; MU=85; Line 75,-40,0; MU=80      /Laser display and sound effects.
250 Line 0,0,3; MU=85; Next Z
260 If X<2 If X>-2 If Y<2 If Y>-2 Goto300        /Is target lined up with crosshairs(±1)?
270 Gosub 440; If      Goto 330                  /If not, goto warship's return fire.
280 If S=0 R=R+   Goto330                        /Are we out of ammo?
290 Goto210
300 For Z=1 to 6; Box X,Y+1,33,10,3
310 For W=55 to 65; MU=W                         /Display direct hit sequence w/sounds.
320 Next W; Next Z; R=R+2
330 R=R-1; Next C; Goto 540                      /This round is over
340 Print "     Novice - Grade 1",; Return
350 Print "   Technician - Grade 2",; Return
360 Print "      Scout - Grade 3",; Return
370 Print "      Cadet - Grade 4",; Return
380 Print "     Ranger - Grade 5",; Return           /Titles and rank
390 Print "    Sergeant - Grade 6",; Return
400 Print "     Captain - Grade 7",; Return
410 Print "      Major - Grade 8",; Return
420 Print "     Warrior - Grade 9",; Return
430 Print "       Fleet Commander",; Return
440 If X<3 If X>-3 If Y<3 If Y>-3 A=520; G=1; Goto 460 /Did target's lasers hit us?
450 A=530
460 For W=80 to 62 Step -3
470 Box X+7,Y,83-W,83-W,3; MU=W
480 Box X-7,Y,83-W,83-W,3; MU=W-1              /Target's laser display & sound effects.
490 Next W; Box X,Y,35,21,2
500 Gosub 510; Gosub A; Return
510 CY = 32
515 Print "    26 spaces"; CY =32; Return
520 Print " You have been terminated!"; Return
530 Print "        He missed!"; Return
540 Clear; Print; Print "     Congratulations!"
550 Print; Print "     You made rank of"       /Display final ranking.
560 Gosub R x 10 + 330
570 CY = -32; Gosub 515; CY = -32
580 NT=0; Print " Press trigger to go again"    /Strobe effect
590 If TR(1)=0 Goto 570
600 Goto 60
```

Program listing.

TR(A) produces a number, either 0 or 1, depending on the position of the A hand-control trigger. JX (A) produces a number, −1,0 or 1, depending on whether the A knob is left, center or right. JY(A) is similar but is dependent on whether the A knob is back, center or forward.

A print command preceding the above will display the number being generated by that command (i.e., print JX (A)). All controller functions can be used to vary color, motion, sound and graphics. Typical commands might include:

IF TR(1) = 1 MU = A—If trigger 1 is pulled, sound the musical tone A.

BC = KN(2) + 127—Set background color according to the knob 2 position.

LINE X,Y,JX(1) + 1—Draw a line of background color, or foreground color, dependent on joystick 1 position.

Music

Musical tones are produced with either the PRINT command or the MU = command. Setting MU equal to numbers between 33 and 88 will produce a full range of tones. However, music is more easily programmed with the PRINT command.

PRINT operates in the normal BASIC fashion, except that musical tones accompany each printed character. The duration of these tones is controlled by the command NT (note time), with NT = 0 producing zero duration. As NT increases, so does the duration of the tones. NT can be changed at any time. The tones span three octaves and are complete with flats and sharps.

Text

Print formatting is accomplished by the use of Print # A,B. (In a field of A spaces, print the number in the B register.) CX is the horizontal tab cursor control (i.e., CX = 10). CY is the vertical tab cursor control (i.e., CY = 20). Print SZ will display the number of unused memory locations.

Characters may be placed on the screen with the use of the TV = command. Only numbers are recognized, and they are identical to the ASCII character representations for decimal numbers between 32 and 94. Other numbers up to 119 designate other characters and command words such as GOSUB, LIST, etc.

Recognition of any depressed key is accomplished with the KP command. Normal use would be A = KP. The number of the pressed key is stored in the A register. It can also be used in other statements (i.e., IF KP = 116 GOTO 320: If the PRINT key was pressed, go to 320).

String Functions

Individual subscripted variables are accessed via the @ (X) command, where X is a number between 1 and 900. Letters and other characters may be stored and recalled with this command. For example, the following program will produce and display the complete alphabet.

```
10 For A = 1 to 26
20 @ (A) = A + 64
30 TV = @ (A)
40 Next I
```

Characters stored via strings are supposedly stored in a separate memory bank and do not affect program storage. However, mine seems to have 900 variables with no program in memory and less than 900 with a stored program.

Processing Speed

The timing benchmarks in the October 1977 *Kilobaud* ("BASIC Timing Comparisons," p. 20) were run on the Bally BASIC with the following results:

Benchmark#	1	2	3	4	5	6	7
Time in sec.	3.2	39	66	67	86	117	201

This is not fast in comparison to other published results, but it is certainly respectable. A converted Shell Sort program with 100 random numbers consistently gave results under two mintues.

All arithmetical operations are performed in Integer BASIC, somewhat limited for calculations, but adequate for programming games.

Conclusion

All in all, the Bally Arcade with the BASIC ROM has proven to be a fun machine. I purchased mine at Montgomery Ward for $269 plus $50 for the BASIC cartridge. Although my first Arcade suffered from overheating problems (quickly exchanged by Ward's personnel), my second has given undying performance. Of course, I am looking forward to having the full-blown processor (Bally now promises delivery of their full-size keyboard in early spring of 1980), but for now the Tiny BASIC will suffice.

I must give praise to Dick Ainsworth for his well-written instruction manual. It is an easy-to-follow guide to Tiny BASIC and includes a number of sample programs detailing the capacity of the Arcade.

I have included one of my family's favorite programs (see the program listing) to give you an idea of the diversity and creative use of the special Bally commands. It is based on the TV show "Battlestar Galactica" and utilizes one joystick for operation. It is both challenging and fun. Be the first on your block to become a fleet commander. ■

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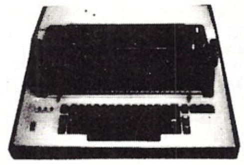

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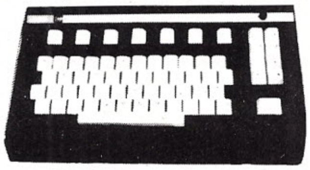

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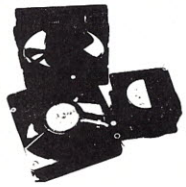

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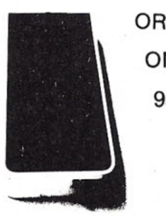

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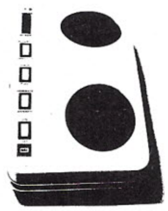

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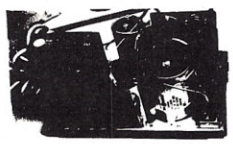

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Build the Output Buffer/Driver

Wherever your micro is located, this circuit gives it control of external devices.

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One interesting, as well as practical, application of microcomputers is the control of external devices. However, in order for a computer to control any given external device, it must be suitably interfaced with that device. Interfacing microcomputers with external equipment is required since I/O (input/output) chips used in microcomputers employ TTL logic levels, which generally are not useful for direct control of most electrical hardware.

Thus, interfaces that are used for microcomputer control of external devices provide the electronic circuitry necessary for conversion of TTL logic levels to signals compatible with the particular device to be controlled. In this article, we describe the Output Buffer/Driver, which is simply an interface that permits computer-controlled, independent, dc-current switching of multiple external devices from a TTL-compatible I/O port.

Theory of Operation

Shown in Fig. 1 is a schematic diagram for a single channel of the Output Buffer/Driver (all channels, at least for our purposes, are identical). The LM555N is a popular IC timer, which is configured in this circuit as a monostable multivibrator ("one-shot").

Grounding input pin 2 on the 555 turns it on for a fixed period of time determined both by the 1 uF capacitor and by the setting of the 1 megohm potentiometer. The 1000 Ohm pull-up resistor at pin 2 both minimizes spurious triggering of the 555 due to voltage transients and sets the current-sinking required to trigger the 555 at about 25 mA. When the 555 turns on, output pin 3 goes "high" for the set timing period.

The values shown in the schematic allow fine adjustment of timing periods up to two seconds duration (the maximum period may be lengthened by increasing the value of the 1 uF timing capacitor to 5 or 10 uF).

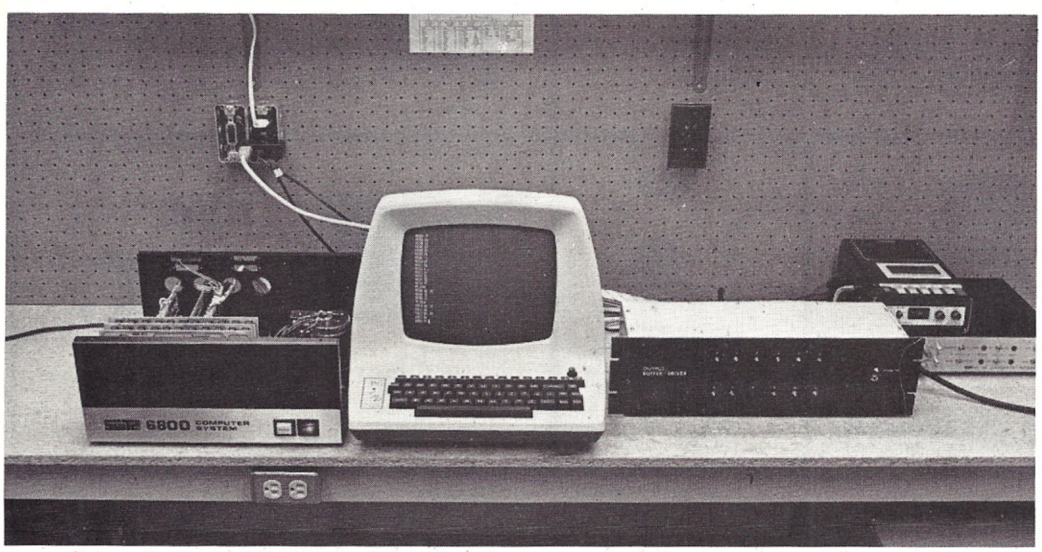
The 555 output voltage drives both an LED (light-emitting diode) "ON" indicator lamp and the base of the 2N3055 NPN power transistor. Base current is limited to about 50 mA by the 100 Ohm resistor.

With base current flowing (555 on), the collector-emitter junction conducts, allowing current-sinking up to about 2 A (at 24 volts) at the collector. Any voltage, up to the 2N3055's collector-emitter breakdown voltage of about 90 volts, may be switched to ground if the transistors are not allowed to overheat due to excessive current consumption (for our purposes, the transistors are used to switch 24 volt devices at high rates, and no heat-sinking of the transistors has proven necessary).

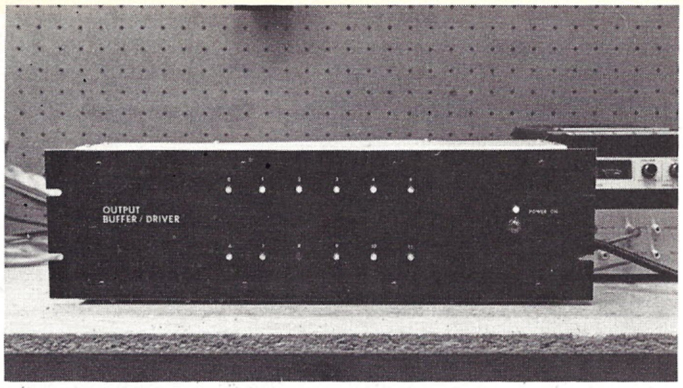
The 10,000 Ohm base resistor biases the transistor toward the "OFF" state when the 555 has timed out. The 1N4004 diode serves as an arc suppressor when driving high-current relays, solenoids or other inductive loads. The Output Buffer/Driver is designed to work off any 5 volt filtered and regulated power supply that can furnish 150 mA per channel.

Construction

Construction of the printed



The 12-channel Output Buffer/Driver (right) as part of the authors' 6800 system.



Front view of the authors' 12-channel Output Buffer/Driver installation. Holes are provided in the panel under each LED allowing adjustment of the ON time for each channel.

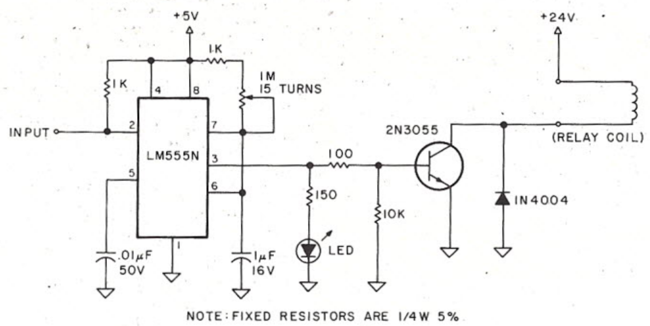


Fig. 1. Schematic diagram for one channel of the Output Buffer/Driver. Although in the diagram a relay coil is shown connected to the 2N3055 output transistor, any dc load (such as a lamp or solenoid) would be suitable.

circuit board is quite simple and concise. Fig. 2 is a full-size PC foil pattern for a six-channel Output Buffer/Driver, while Fig. 3 shows component placement for a single channel. All components are readily available from James Electronics (with the exception of the 2N3055s, which can be obtained less expensively from Integrated Circuits Unlimited, San Diego CA). Cost is about $25 for a six-channel board, including sockets for the 555s and Cliplites for the LEDs.

If the PC board is to be enclosed in a cabinet, a front-panel layout and PC-board positioning similar to the ones in the photos are recommended. The PC board is mounted with its front edge (the edge closest to the 1 meg pots) as close as possible to the front panel. Holes are then drilled in the front panel to permit access to the 1 meg pots.

Immediately above each access hole, a second hole is drilled for installation of the Cliplites that hold the LEDs in position. The LEDs are connected to the PC board by short (4- to 5-inch) lengths of twisted hookup wire.

This arrangement has proven to be the best of several that we have tried because it facilitates reading and interpretation of output ON-OFF patterns, especially when they are occurring rapidly and changing often. We have also found it convenient to run the load-switching wire and the trigger input wire of each channel to a terminal strip in order to increase flexibility of the unit. Some effort should be made to separate input and output wires in order to prevent spurious triggering of the 555s.

After constructing the PC board and connecting it to a 5 volt power supply, test each channel by briefly grounding its trigger input. This should cause the LED corresponding to that channel to be illuminated. Ad-

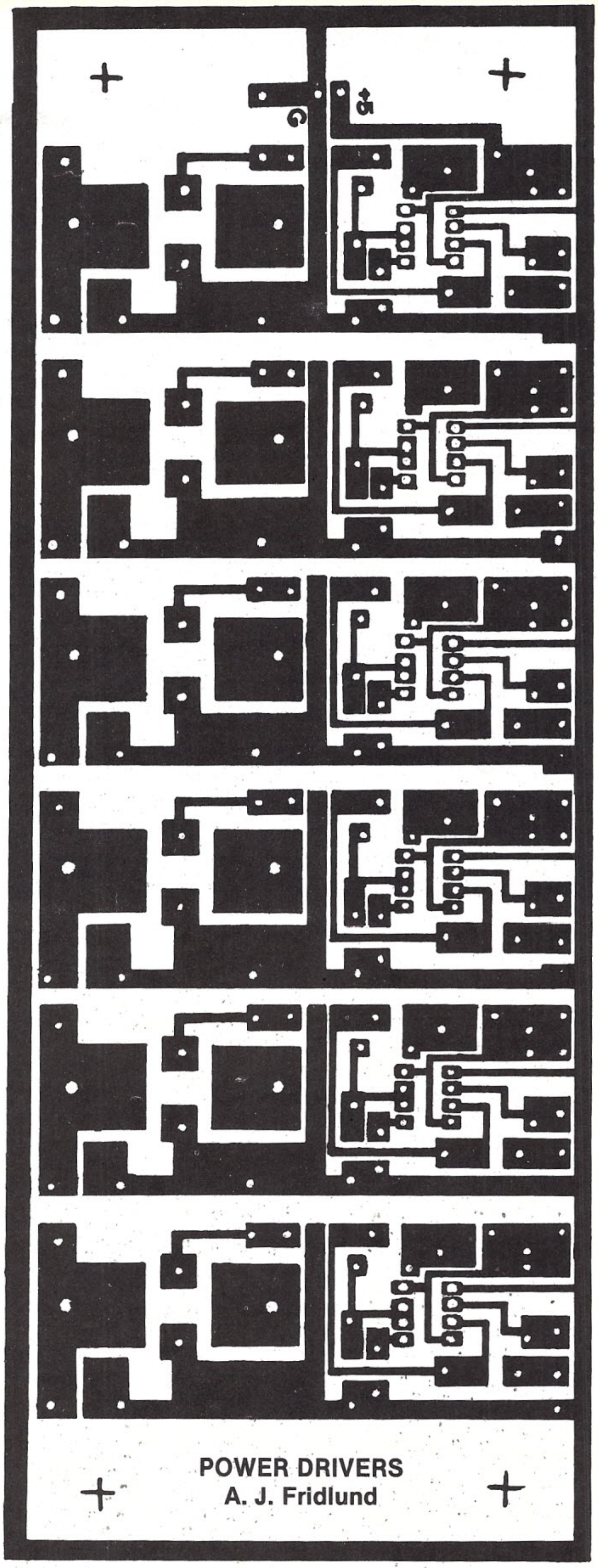
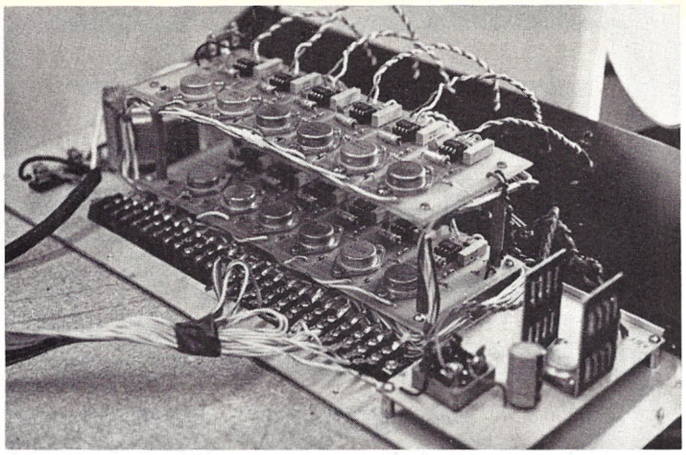
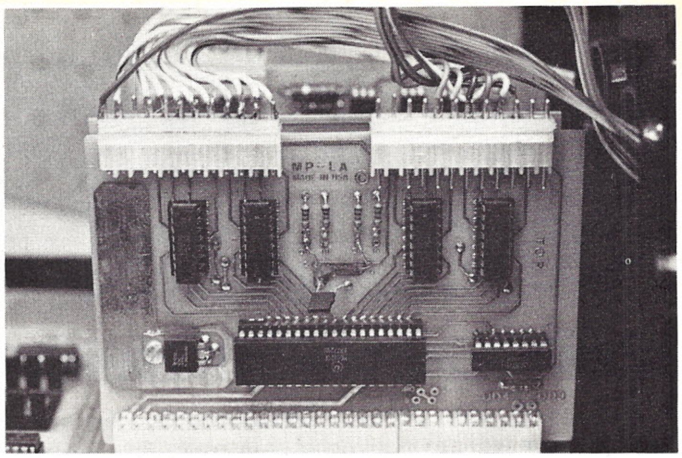


Fig. 2. Full-size PC board foil pattern for a six-channel Output Buffer/Driver installation.

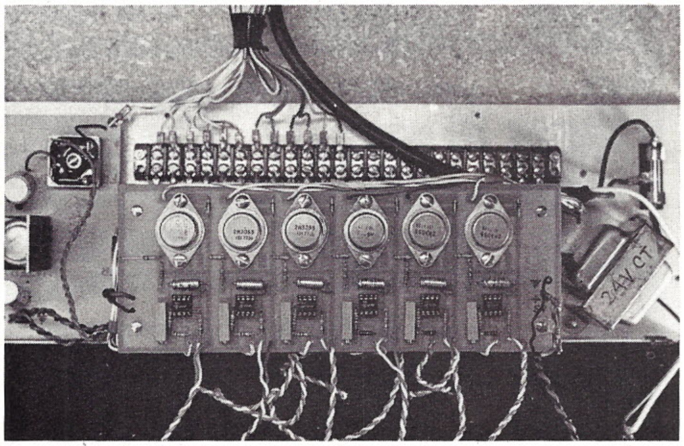
justing the 1 meg pot for that channel should change the duration that the LED stays on, indicating the duration of the "ON" state of the channel. It might also be wise to put an



Rear view of the authors' installation showing the main terminal strip that connects inputs and outputs for each channel.



Close-up of the SWTP MP-LA parallel interface card showing connections to the 12-channel Output Buffer/Driver and A and B data lines configured for output.



Overhead view of the six-channel board showing component layout and position of adjustment pots with respect to the front panel.

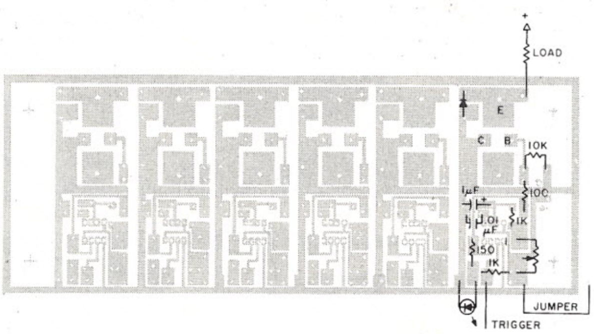


Fig. 3. Component placement for a single channel of the Output Buffer/Driver circuit. Note that jumper wires connect adjacent channels to the 5 volt supply on the six-channel board.

Channel On	Hex Value Stored In Location 8010
0	01
1	02
2	04
3	08
4	10
5	20

Fig. 4. Chart showing the hexadecimal values that operate each channel.

ammeter between the trigger input wire and ground for each channel during checkout to ensure that trigger current levels are about 25 mA.

Application

As mentioned earlier, the Output Buffer/Driver can be used to control switching multiple dc devices. In our application, we constructed two six-channel boards, allowing control of up to 12 separate devices. Devices that use the same voltage and that are to be switched simultaneously may be controlled by a single channel. In addition to this, ac devices may be switched by using the Output Buffer/Driver to control a relay.

Although the Output Buffer/Driver can be employed with any TTL-compatible parallel output port capable of sinking at least 25-30 mA, we will describe its use with the SWTP 6800 microcomputer.

The SWTP 6800 provides eight I/O ports designated 0-7. For interfacing the Output Buffer/Driver, we obtained an SWTP MP-LA parallel interface card and plugged it into I/O port #4. Each MP-LA has two separate sets of connectors (an A set and a B set) located along the top edge of the card. Each connector set may be configured for either input or output. Since our Output Buffer/Driver installation has 12 channels, both sets of connectors were wired for output according to the MP-LA assembly instructions.

Within each connector set there are eight data lines designated A0-A7 and B0-B7. Using a piece of multiconductor ribbon cable, we connected data lines A0-A5 to the trigger inputs of channels 0-5, respectively (we numbered our channels from left to right facing the front edge of the PC board); data lines B0-B5 were connected to the trigger inputs of channels 6-11. The MP-LA ground was then connected to the ground of the Output Buffer/Driver.

The 6800 microprocessor handles input and output in the same manner as reading from, or writing in, any memory location. The specific memory locations designated for I/O port #4 in the SWTP 6800 are 8010 for the A connector set and 8012 for the B connector set.

When the 12-channel Output Buffer/Driver is connected to the MP-LA positioned in I/O port #4, the ON-OFF pattern of the channels depends on the values stored in locations 8010 and 8012. For example, if the value 00 is stored in 8010, data lines A0-A7 will be TTL logic "high," and channels 0-5 will be in an OFF state. On the other hand, if the value FF_{16} is stored in 8010, all data lines will be TTL logic "low," allowing the trigger inputs to be pulled down, and channels 0-5 will be in an ON state.

Furthermore, any individual channel may be turned on by depositing the correct value in

the proper location, as illustrated in Fig. 4. Similarly, any combination of channels may be turned on by simply adding the values of the individual channels to determine the value that will result in the desired ON-OFF pattern, as shown in Fig. 5.

The program in Fig. 6 can be used to demonstrate Output Buffer/Driver operation. This program takes hexadecimal values from the keyboard and displays these values briefly (for the duration of the "one-shot") on the Output Buffer/Driver LEDs as the corresponding ON-OFF pattern.

Conclusion

The particular Output Buffer/Driver circuit presented here is the result of quite a bit of trial-and-error engineering, and actually represents the fifth or sixth revision of the initial circuit. For our purposes, which involve control of many types of laboratory equipment, we have found this last revision to be most suitable. Although you may want to adapt the circuit for your own specific purposes, the present design nevertheless provides an adequate means for microcomputer control of many external devices.■

Channels On	Hex Value Stored In Location 8010
0 and 1	03 = (01 + 02)
1 and 2	06 = (02 + 04)
4 and 5	30 = (10 + 20)
2, 3 and 4	1C = (04 + 08 + 10)

Fig. 5. Chart showing how hexadecimal values that operate combinations of channels are derived.

```
0300   BD   JSR E055     Jump to MIKBUG Input Byte subroutine.
0301   E0                Inputs hex byte from keyboard and stores
0302   55                binary equivalent in the A accumulator.
0303   B7   STA A 8010   Output to data lines A0-A6.
0304   80
0305   10
0306   86   LDA A 00     Clear A accumulator.
0307   00
0308   B7   STA A 8010   Clear data lines by storing 00 in 8010.
0309   80
030A   10
030B   7E   JMP 0300     Do it again.
030C   03
030D   00
```

Fig. 6. Program to demonstrate use of the Output Buffer/Driver. Hexadecimal values are taken from the keyboard and displayed as ON-OFF patterns on the Output Buffer/Driver LEDs.

As psychologists, we are generally interested in the study of behavior. More specifically, we are interested in two rather diverse research areas. The first involves the study of the effects of drugs and brain damage on control of voluntary movement, while the second is concerned with muscle patterning and biofeedback. Our computer systems, then, (we have three systems: two PDP8/e's and a SWTP) are configured to collect data and to control the occurrence of specified programmed events in the experiments that we conduct in these research areas. The output buffer/drivers, of course, are the means by which the computer controls events we may wish to program. In particular the computers, through the output buffer/drivers, can control the switching of solenoids which, in turn, can control the delivery of food or water to hungry (thirsty) experimental animals. The food or water is used as a reward when the animal satisfactorily performs some desired task. In addition to the delivery of rewards we have used the output buffer/driver circuit to control a variety of other events including lights, tones, buzzers, timers and clocks, as well as other laboratory equipment. —Authors.

✓ Reader Service—see page 227

Micropolis Disk Drives

And they're a good bargain, says the author of this comprehensive review.

Thom Hogan
719 Anna Lee Lane
Bloomington IN 47401

Micropolis is a name you've probably been hearing quite a bit about lately. Both Vector Graphic and Exidy have signed contracts with Micropolis to provide disk drives for their MZ and Sorcerer computers. Several other manufacturers, most notably Computer Data of Delaware, have been shipping computers with Micropolis drives for some time now.

Just what is the Micropolis and why does it seem that everyone is jumping onto their bandwagon? Do the Micropolis drives offer any advantages over the North Star? What about software? (A disk is only as good as its operating system allows it to be.) By the time you've finished reading this article, you should know the answers to these questions.

The Technical End

Micropolis has made a reputation of squeezing every usable byte of information onto the 5 1/4 inch minidiskettes. For this extra storage, the user must make the sacrifice of using 16-sector hard-formatted diskettes. Most of the minis on the market use either 10-sector hard- or soft-sectored minidiskettes and have a capacity of between 90-100K bytes. The minimal Micropolis configuration supplies 143K of storage capacity per disk.

Micropolis refers to these drives as Mod Is, and the model numbers available are 1041, 1042, 1021 and 1022. The 1041 is a drive with controller board, but no power supply; the 1042 is a 1041 with a power supply; the 1022 is a single drive; and the 1021 is just a drive unit—no software, controller or power supply.

If there is a Mod I, it will follow that there is also a Mod II. Mod II Micropolis drives are dual density and give the user 315K of mass storage per diskette. Again, you can purchase just a drive (1023), a drive with a controller and software (1041—yes, the same number as a Mod I!) or the entire unit, which includes power supply (1043). All Micropolis products come completely assembled and tested.

Actually, learning the Micropolis numbers game is the most difficult thing about the system. If you've managed the above numbers, your patience may be tried when you learn that there is a whole set of *different* numbers for dual drive systems. Micropolis seems to realize that this whole mess can be confusing, and in their advertising they talk mainly about Macrofloppies (Mod Is) and Metafloppies (Mod IIs).

Once you've deciphered the model number of the drive that matches the storage capacity you need, the fun begins. If you order a system (more than just the drive), you'll receive an S-100 bus controller, a ribbon cable, the drive unit, a 100+ page manual in a slick-looking white binder and two diskettes (both of which have the software masters for MDOS and Microsoft BASIC). A power cable is included when you order a 1041 or 1021 with a power regulator to use the computer's power supply.

As tempted as you might be to try out the drive right away, don't. Start by reading the manual. Within 20 pages, you'll be operating your system.

Micropolis does an excellent job of providing step-by-step instructions for setting up your drives. They include detailed references to input and output drivers for the most popular computers. For those of us who have printers, Micropolis also provides for printer drivers on the system disk.

When properly assimilated, the printer driver allows the user to turn the printer on or off from BASIC or from the line editor. The driver routines provided by Micropolis cover most of the particulars needed to work with Teletypes and other popular printers.

After you've followed the clear instructions and created your own system disk, you're ready to bootstrap the DOS by executing at F400 hex (alternatively, you may relocate the bootstrap to any 1K boundary from C000 to F000 hex). As with all of the Micropolis software, MDOS signs on by identifying itself and its version number. You won't really appreciate this added touch until you've worked at a computer store where there are 30 disks crammed into a file box and you're not sure which version of DOS and BASIC you've got (North Star, take note).

The quality of the mechanism Micropolis makes is also quite good. Inserting a diskette is not an iffy situation. It is easy to feel if the diskette is all the way in and properly seated. As with most drives, you can't close the latch if the diskette is improperly seated. If you're gentle, you'll never damage a diskette and you'll be reassured by the authority with which the Micropolis latch closes.

Also, after a few seconds without disk access, the Micropolis shuts off the head/diskette contact so that undue diskette wear won't occur. This really doesn't hurt access time, as contact is instantly reestablished when an access occurs. As with the North Star, a small red light comes on to indicate when the disk is being used.

When you want to take out your disk, simply open the door, then push the lip of the door back in the other direction—the diskette will then be ejected.

A word of warning should be issued to those who attempt to operate the Micropolis off the computer's power supply. First, be careful that your computer has enough power left to supply. Figure that the disk will take 1.5 Amps and that you should play it very safe (with Sols and Polys you should be extra careful—they become awfully hot as you get close to their power capacity).

Second, be aware that on some systems the power supply is not adequately separated from the video circuitry. What happens in this instance is that the video display is interfered with—a problem that can be alleviated with some simple bypass circuitry, but it is still a problem.

Software and Disk I/O

Software is what really makes a disk system viable. The Micropolis software includes

MDOS (Micropolis Disk Operating System), a dynamic debugger, an assembler, a line editor and a Microsoft BASIC. In addition, printer drivers and various system utility routines are available on the system disk. Each of these deserves to be considered individually.

MDOS has no really unique features, but it is concise and easy to use. Unlike the two character keywords used by many systems, Micropolis commands are easy to understand. To get a list of the files on a disk, simply type FILES, followed by the number of the drive you want cataloged. To run any file that is immediately executable (not BASIC programs), you simply type the name of the program and follow it with a carriage return. To load BASIC when you're in MDOS, then, just type BASIC and return.

Other commands are also easy to use. To initialize a diskette, you type INIT and the number of the drive on which the unformatted diskette is. MDOS will query, "ARE YOU SURE?" If you answer YES, the initialization process will begin; any other answer aborts the command. This last-second check is just one of the many subtle touches that make one appreciative of the thoroughness of the Micropolis system.

Besides providing disk commands, MDOS is also a monitor system. You can DUMP memory, FILL an area of memory with a certain hexadecimal character, ENTR new data to memory or execute, beginning from any address.

Another nice touch of MDOS is that the monitor system you're using is still functional. In other words, if you have a Sol, the cursor controls still work, and the rubout key also still performs its function. It's almost like having the best of both worlds.

Some mention should be made of Micropolis disk I/O specifics. File names can be up to 10 characters long, thus making the contents of the file more recognizable by name. How many times have you scratched your head attempting to figure out what the files MTCHS or AR010 contain? With the Micropolis, the aforementioned programs would be more easily understood as MATCHES and ACCT.REC.1.

When you save a file from BASIC with the same name as one already on a diskette, MDOS replaces the file on diskette with the one in memory. To save a new program, an N: before the file name is all that is needed. Those who have used early North Star DOS will appreciate this last feature, as it eliminates the necessity of creating a file in DOS before saving it from BASIC. File length is 250 characters per record.

Other instructions can be given MDOS at the same time as a SAVE instruction. You can specify the drive on which to do the saving, or you can give the file a TYPE different than the one under which it would normally be saved (write protection, for example).

Since file names in MDOS are treated as strings (enclosed in quotes), you'll find that in BASIC you can use a string variable as a file name. The nice thing about this is that the program user can name data files while running the program. A simple input statement before an OPEN file statement is all that is necessary. See Example 1. In short, those who take the time to learn the system will be able to accomplish a great deal with few keystrokes.

The one thing that might throw newcomers to the Micropolis system is the semantics of disk I/O. There are no READ and WRITE statements. Instead, Micropolis uses GET and PUT statements.

In addition, many options are included with these statements. First, you could have several files open at once, as in Example 2. Second, you are able to assign the GET and PUT pointers to any logical file record number. As already mentioned, each logical file record in the Micropolis system has a length of 250 characters. You can specify which record something is to be put onto or taken from with ease, simply by adding another number to the GET or PUT statement (see Example 3). Random accessing of information is certainly easy using this approach.

There is one negative aspect of Micropolis's disk I/O system. When you are saving strings in a BASIC data file, they must be separated by a comma delimiter. This makes for some extra typing on PUT statements, especially if you have a great number of strings to store. Micropolis recommends that you dedicate one string variable to be a delimiter and store it with your strings, as in Example 4.

The Line Editor

The line editor that comes with the Micropolis has features similar to those of a word processor. Besides being designed to number and format assembly-language programs automatically, it gives the user the option of having the output presented to the screen or printer as it is entered (i.e., as text).

Since the line editor has provisions for large-scale changes (deleting whole lines, changing strings or deleting sections between given line numbers) or character changes (replacement, deletion or insertion of characters), the line editor is a versatile tool for those interested in word processing. Putting together a text-formatting addition to the editor to make a complete word processing package would be relatively easy.

BASIC

I've already mentioned that the BASIC with the Micropolis is a Microsoft BASIC. Anyone who has tried many of the BASICs on the market is sure to recognize that Microsoft has one of the better ones. The Micropolis version is one of the most extensive Microsofts I've seen and, as such, is capable of most anything that can be accomplished in BASIC. All lines can have multiple statements of up to 250 characters. A full set of string variable modifiers is available, and this feature greatly facilitates language processing, something that is not always compatible with the mathematical nature of BASIC.

You might be worried about

```
100  INPUT"WHAT FILE NAME (UP TO 10 CHARACTERS)",A$
110  OPEN 1 A$
                    OR
100  INPUT"WHAT FILE NAME (UP TO 10 CHARACTERS)",A$
110  B$ = "N:" + A$
120  SAVE B$
```

Example 1.

```
10  OPEN 1 "JUNKONE"
20  OPEN 2 "JUNKTWO"
30  OPEN 3 "JUNKTHREE"
40  GET 1 A$              (GET FROM FILE #1, A$)
50  GET 2 B$
60  GET 3 C$
```

Example 2.

```
10 OPEN 1 "JUNKONE"
20 PUT 1, RECORD 1, A$ (PUTS ON FILE #1, RECORD #1, A$)
```

Example 3.

```
10  Z9$ = ","
20  OPEN 1 "EXAMPLE"
30  PUT 1, Z9$ + A$ + Z9$, Z9$ + B$ + Z9$, Z9$ + C$ + Z9$
40  CLOSE 1
50  OPEN 1 "EXAMPLE"
60  GET 1, A$, B$, C$
```

Example 4.

the size of the BASIC as compared to your system's memory size. After all, 22K is a lot of RAM space dedicated to a language and disk I/O. Don't worry too much about lack of RAM, however. If you have 32K you most likely will have more than enough, as long as you do a bit of preplanning on complex programs.

Micropolis BASIC allows you to CHAIN programs. CHAINing is more than just loading another program from the disk and running it. True CHAINing means that all values of variables are passed to the new program from the program that was previously in the program stack. This allows you to split a long program into two shorter ones with just a little bit of forethought. True, having to access the disk every now and then will slow down processing time on complex programs, but I doubt that this delay will bother those who just saved an extra $200 in memory-expansion costs. (One exception: If you run Lifeboat Associates CP/M conversion for the Micropolis, you really ought to set up a 48K system as a minimum.)

Negative Comments

So far, this review has been relatively positive about the Micropolis system. There are a few things that could be improved or reconsidered, however. The three items most likely to bother you are: location of the software, availability of 16-sector hard diskettes and the lack of an editing feature in BASIC.

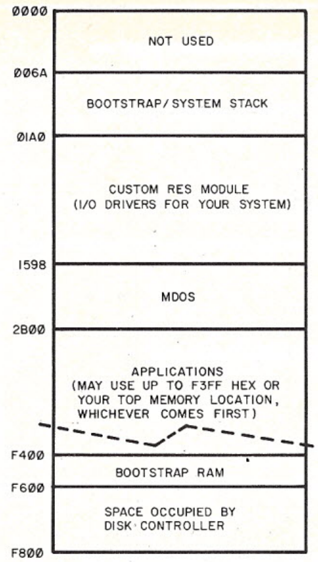


Fig. 1. Version 4.0 MDOS software.

The software for the Micropolis begins at 0000 hex. RES and MDOS take up most of an 8K board (see Fig. 1), and, if you also load BASIC, the first 22K of RAM space will be used up. Since a good deal of existing software begins at the bottom of RAM memory, it is impossible to load some of your cassette software without doing an extensive relocation job. In addition, owners of Poly 88s, Cromemco one-board computers and any other computer that has a monitor start-up location of 0000 hex will have a major conflict to resolve.

There are three methods of correcting the problem: (1) Buy Micropolis's relocated software (origin of 2000 or 4000 hex), (2) kludge a phantom capability onto your present CPU or (3) dump your present monitor and wire your system to jump-start at F400 hex, the Micropolis bootstrap location (this means writing your own I/O routines).

The second problem, availability of diskettes, is a minor inconvenience, but still an inconvenience. Unless your local computer shop has been selling Micropolis drives, they're not likely to stock 16-sector hard diskettes. The solution is to mail-order your diskettes, and if you're careful about this, you'll save some money in the process. Recent magazine ads have diskettes selling at a price anywhere between $3.80 and $5.50 each. Retail is $5.50 (at least here in Bloomington), so by ordering ten diskettes by mail order, you could save as much as $15.

Not having an editor in BASIC won't be much of a problem for some of you. Micropolis has announced that version 4.0 of BASIC will have a line and character editor built in. That means that you should make sure you're getting the latest revision of software with your drive.

If you buy a version 3.0 Micropolis and want to move up to a 4.0, it's going to cost you an extra $75. Micropolis does an excellent job of keeping its customers up to date on revisions, modifications and new software, with the only drawback being that you must pay to obtain them.

Conclusions

The Micropolis disk systems offer the home or small-business computer operator a reliable and effective alternative to the full 8 inch floppy disks. Ease of operation is certainly a strong point, but the software and documentation are the real gems of the Micropolis system.

Microsoft BASIC, an assembler, a line editor and an excellent DOS make for a complete beginning software package. With CP/M, the Micropolis owner can now add Microsoft COBOL and FORTRAN or any of the Xitan software. Micropolis adds a thorough documentation package, certainly far more complete than North Star's package, and rivaling even Digital Research's series of CP/M manuals.

If you're shopping around for a minidisk system, take a long close look at what Micropolis is offering; I think you'll like what you see. ■

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MC 68B21—9.99
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✓ Reader Service—see page 227

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University of Pittsburgh
Pittsburgh PA 15260

Weight-Watching Special

If your body looks like a bell curve, take a look at this application.

The best bet for making numerical output from a program useful is to show it in graphical form. Pictures make output easy to interpret and even easier to remember.

Most personal computer systems have an alphanumeric output device (either hard copy or CRT type) on which simple but useful graphs can be plotted by using the TAB(X) function in BASIC. The main difficulty is that the range of numbers to be plotted seldom matches the number of columns across the page (or screen) of the terminal.

Also, terminals vary. Many CRT screens are limited to 40 columns, while hard-copy terminals can handle 80 or even 132 columns. The solution to both these problems is to scale the numbers to be plotted to a range that fits on the terminal being used.

Program A.

```
10 PRINT"WEIGHT WATCHER'S RECORD"
20 PRINT:PRINT"WEEK","WEIGHT","WT. LOSS"
30 S=0: D=0
35 REM-----CALC. & PRINT TABLE----------
40 READ G
45 I=0
50 I=I+1
60 READ W
70 IF I=1 THEN 110
80 IF W<0 THEN 140
90 D=W1-W
100 S=S+D
110 PRINT I,W,D
120 W1=W
130 GOTO 50
140 PRINT:PRINT"AVG. WEEKLY LOSS  ";S/(I-1);"LBS."
150 PRINT"LBS. TO GOAL  ";W1-G
160 PRINT"TOTAL POUNDS LOST SO FAR  ";S
170 PRINT:PRINT"WEIGHT WATCHER'S GRAPH":PRINT
175 REM-----STANDARD SCALE(100-200)----------
180 A=100:B=200
190 GOSUB 315
250 REM-----CUSTOMIZED SCALE----------
260 PRINT:PRINT"WANT A CUSTOMIZED GRAPH";:INPUT A$
270 IF A$="NO" THEN 999
280 PRINT"WHAT IS THE SMALLEST NUMBER YOU WANT(INSTEAD OF 100)";
290 INPUT A
300 PRINT"WHAT IS THE LARGEST NUMBER YOU WANT(INSTEAD OF 200)";
301 INPUT B
303 GOSUB 315
305 PRINT"WANT ANOTHER GRAPH";:INPUT A$
307 IF A$="YES" THEN 280
309 GOTO 999
315 REM-----GRAPH SUBROUTINE----------
316 X=0
317 REM-----HEADING(LINE 1)----------
330 FOR I=A TO B STEP 10
340 PRINT TAB(X*10*(50/(B-A))+5);I;
350 X=X+1
360 NEXT I
370 PRINT
375 REM-----HEADING(LINE 2)----------
380 PRINT"    I";
390 FOR I=0 TO (X-1)
400 PRINT TAB(I*50*(10/(B-A))+7);"+";
410 NEXT I
420 PRINT
425 RESTORE
426 READ G
428 REM-----PRINT GRAPH----------
429 I=0
430 I=I+1
440 READ W
450 IF W<0 THEN 480
460 PRINT I;TAB(4);"I";TAB((W-A)*(50/(B-A))+6);"*"
470 GOTO 430
480 RETURN
900 DATA 122,153,149.5,147.5,147.5,145,144.5,141,141.5,139.25
910 DATA 139.5,137.5,138.5,-1
999 END
```

SUBROUTINE 315-480 IS USED FOR BOTH THE STANDARD AND CUSTOMIZED SCALES. THE VALUES OF A AND B MAKE THE DIFFERENCE.

Scaling actually involves two operations. The first is an addition (or subtraction) of a number that *translates* all the data. The second is a multiplication by a number called a *scale factor*.

For example, suppose you want to plot a graph of a dieter's weights from 100 to 200 pounds, but you want to squeeze the graph into 50 columns on a terminal. Terminals have columns numbered 0, 1, 2, 3, . . . etc. So the first thing is to translate (which here means move left) all the weights so that 100 pounds corresponds to column zero on the terminal. This is done by subtracting 100 from each weight (W).

The next problem is to squeeze the weights from 100 to 200 into 50 terminal spaces. This can be done by multiplying each weight by a scale factor of 50/(200-100) = ½ terminal spaces per pound. For example, for a weight of 150 pounds, the program should first translate this weight by taking 150 − 100 = 50. It should then scale it by taking 50*½ = 25 terminal spaces. Fig. 1 is a picture of what happens.

This is done in BASIC by

```
PRINT TAB((W – 100)*(½);"*"
```

Since multiplying by ½ is the same as dividing by 2, this can be simplified by writing

```
PRINT TAB((W – 100)/2);"*"
```

To improve the readability of the graph, we can also print the week in which each weighing was made. To do this we'll reserve six spaces on the left for printing X (the week number) in column 2, and the symbol I in column 4 (see Example 1). Thus for X=21 and W=150 we'd have, as part of our graph, the format shown in Fig. 2.

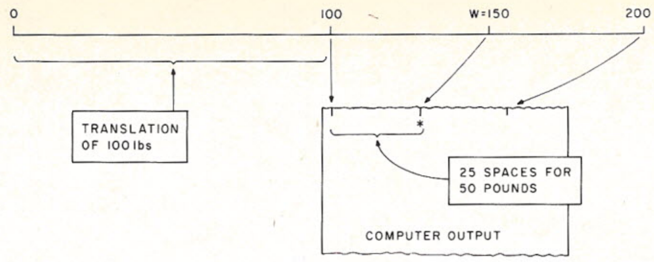


Fig. 1.

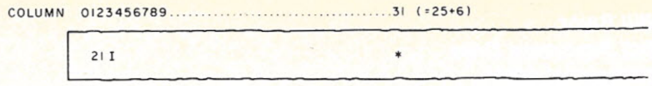


Fig. 2.

Automatic Scaling

We can generalize this idea by using a starting weight called A (instead of 100), and a final weight called B (instead of 200). This makes the scale factor 50/(B – A) spaces per pound. The translation is now A pounds (not 100), and the starting weight at the left edge of the graph is W – A (not W – 100). This gives us the generalized print statement in Example 2. It is also necessary to generalize the headings at the top of the graph, and this is done in a similar manner.

Let's look at a program (Program A) that does all this "customized" scaling in a subroutine (lines 315 to 480). The first time the subroutine is used, the weights go from 100 to 200 (line 180). But then the user is asked to supply a more personalized set of minimum and maximum weights. These are input as A and B in lines 280 to 301.

This program also contains the user's goal weight as the first number in DATA statement 900. This way the program can tell the dieter how many "pounds-to-goal" there are. The – 1 at the end of the DATA is used to stop the READ loop (see line 80).

This program was written for a terminal with 70 columns. On a 40-column terminal, the number 50 in lines 340, 400 and 460 should be changed to 30. A sample run is shown in Fig. 3. The graphing symbols are plotted in line 460 of the subroutine using the TAB function as explained.

Summary

This technique works fine for single-valued functions (where there is only one dependent value for each independent value), but it becomes clumsy for multivalued functions. However, the scaling techniques explained here can be readily extended for use in a "super-plot" program that does automatic scaling and axis-labeling for multivalued functions expressed in general parametric form.

An explanation of how to do this, along with a sample program, is given in Chapter 7 of *BASIC and the Personal Computer* (Addison-Wesley Co., Reading MA 01867). Several examples of plots of parametric equations are also shown there, and it is revealing to see how much information can be conveyed by a graph on an alphanumeric terminal. A general graphing routine is undoubtedly a valuable software addition to any personal computer system. ■

```
PRINT X;TAB(4);"I";TAB((W – 100)/2 + 6);"*"
```

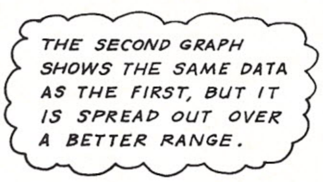
Example 1.

```
PRINT X;TAB(4);"I";TAB((W – A)*(50/(B – A)) + 6);"*"
```

Example 2.

Fig. 3. Sample run.

```
RUN
WEIGHT WATCHER'S RECORD

WEEK          WEIGHT       WT. LOSS
 1             153           Ø
 2             149.5         3.5
 3             147.5         2
 4             147.5         Ø
 5             145           2.5
 6             144.5         .5
 7             141           3.5
 8             141.5        -.5
 9             139.25        2.25
 1Ø            139.5        -.25
 11            137.5         2
 12            138.5        -1

AVG. WEEKLY LOSS   1.2Ø833 LBS.
LBS. TO GOAL   16.5
TOTAL POUNDS LOST SO FAR   14.5

WEIGHT WATCHER'S GRAPH

      1ØØ  11Ø  12Ø  13Ø  14Ø  15Ø  16Ø  17Ø  18Ø  19Ø  2ØØ
    I  +    +    +    +    +    +    +    +    +    +    +
 1  I                           *
 2  I                         *
 3  I                        *
 4  I                        *
 5  I                       *
 6  I                       *
 7  I                     *
 8  I                     *
 9  I                    *
 1Ø I                    *
 11 I                   *
 12 I                    *

WANT A CUSTOMIZED GRAPH? YES
WHAT IS THE SMALLEST NUMBER YOU WANT(INSTEAD OF 1ØØ)? 13Ø
WHAT IS THE LARGEST NUMBER YOU WANT(INSTEAD OF 2ØØ)? 15Ø
      13Ø                      14Ø                      15Ø
    I  +                        +                        +
 1  I                                                          *
 2  I                                                 *
 3  I                                            *
 4  I                                            *
 5  I                                      *
 6  I                                     *
 7  I                            *
 8  I                             *
 9  I                        *
 1Ø I                        *
 11 I                   *
 12 I                      *
WANT ANOTHER GRAPH? NO
OK
```



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A "Pentronics" System

For $10, these enterprising scholastics interfaced a PET to a Centronics 101 printer.

I am a high-school teacher at Huron Valley Lakeland in Milford MI. I teach computer studies . . . among other things; my training is in chemistry, not in electronics or programming. Much of my time is spent troubleshooting our equipment, however.

Doughnuts to Dollars

Perhaps I should back up to explain something about our computer facility before I go on with the story. Catalyst Computer Center of Lakeland High School is owned, operated and funded almost totally by students. Our DEC PDP8/A system and, more recently, our Commodore PET were acquired through student fund-raising, chiefly by the daily sale of doughnuts to the student body before the start of the school day. The cost of each item we buy or have repaired must be measured in terms of how many doughnuts must be sold to cover that cost. As a result of this, we have all learned many things about circuitry; learning-by-doing is an effective method, as I've often told my chemistry students.

At the end of the last school year, we were looking for another source of fund-raising to supplement the doughnut sales—something that actually involved the use of a computer in the process. We tried running biorhythm charts on the PDP system during the spring and, after looking over the results, decided to try doing the charts at several of the many fairs held during the summer, especially since this would allow us to show off our new Commodore PET.

Unfortunately, the "PET Printer" was still a dream at the time this scheme was concocted; all we had was a Centronics 101 that we used on our PDP system. With this unit and its ancient serial interface, together with an IEEE-488 serial adapter for the PET from Connecticut Microcomputer, we were able to exhibit at *one* fair. That's how long it took for the serial board in the Centronics to blow its obsolete shift register (which, I understand, never really was in actual production) and cause us to ask the question, "How do we hook a regular printer to the IEEE?" We did just that, as this article will show, and it cost us only $10!

Pin-out Configuration

As with any modification or repair involving the PET, finding the proper documentation is 90 percent of the solution; this job was certainly no exception. The first printing of "An Introduction to Your New PET" provided a pin-out of the IEEE connector, and even though this is more than is provided in later editions of this booklet, it did nothing toward explaining how to use this port. This pin-out is shown in Fig. 1.

top of connector		bottom	
PET Pin	Signal	PET Pin	Signal
1	DIO1	A	DIO5
2	DIO2	B	DIO6
3	DIO3	C	DIO7
4	DIO4	D	DIO8
5	EIO	E	
		through	Ground
6	DAV	N	
7	NRFD		
8	NDAC		
9	IFC		
10	SRQ		
11	ATN		
12	chassis GND		

Fig. 1. IEEE pin-out. There are two sets of 12-contact double-readout connectors. The IEEE port is the one closest to the line cord on the rear panel of the PET.

After I placed several long-distance phone calls to Commodore, I was still hard-pressed for data even though I now had a "bulletin" from the PET folk, which attempted to describe the signals available at the I/O connectors. I ordered a copy of the IEEE-488 description from A-B Computers of Perkasie PA and spoke with both local and out-of-state engineers who had occasion to use the IEEE interface (non-PET). I knew what the signals were and how they worked, or so I thought. So I began to fabricate a board (see Fig. 2 for interface signals definition).

As in any general-purpose bus, there is provision in the IEEE for multiple devices to be attached to the bus at the same time. Thus I had a lot of studying to do in order to sort out what signals I would need and to construct the device.

The first decision I made was that I wanted a unit as soon as possible. This necessitated that my device not allow simultaneous use of the IEEE by devices other than the printer. That the budget for the device was almost nonexistent reaffirmed that decision.

The way the PET handles the IEEE is as follows. Unlike other buses, such as the S-100, the eight data lines carry all the addresses and commands as well as the data. Therefore, it is necessary to inform the receiving device whether the byte on the bus is data or an address or command.

This is the purpose of the attention (ATN) line, which is pulled low (true) whenever there is either a command or address on the data lines. Our interface board will need to correctly interpret this piece of information, since we wish the printer to receive only printable data and not addresses. (You recall that I said this was to be a quick and inexpensive board—meaning it is going to assume that all the valid data on the bus is intended for the printer, but it must make certain that a data

Signal Name	Description
DIO1 through DIO8	Data I/O Bit 0 through 7 (low is true).
NRFD	Not Ready For Data. A low on this line from a printer indicates that the printer is not ready to accept data. When this line goes high, the next byte is placed on the bus.
DAV	Data Valid. When the PET has placed a valid data byte on the bus, this line is made low and remains low until either the data is accepted or 900 usec have elapsed. It cannot go low while NRFD is held low.
NDAC	Not Data Accepted. The line is held low until the data is accepted. A high tells the PET to take the byte off the bus.
ATN	Attention. This line is pulled low by the PET whenever the byte on the bus is an address or a command rather than a character.

Fig. 2. Description of IEEE signals. Only those used in this application are described.

byte is printable before shipping it out.)

The PET must also have some way of notifying the printer that there is *data available*, and this is the function of the DAV line that is pulled low (true) as soon as there is valid data (including addresses and commands) on the data lines.

In addition to these two outgoing handshake lines, the PET must also be informed when the printer is not able to accept data (busy) and when the current byte on the data lines has been accepted. The former is the job of the NRFD line, which expects to be pulled high when the printer is able to receive the next character and to be pulled low during a busy condition. The latter case is handled by the NDAC line, which expects to be pulled high when the current data byte has been accepted, then allowing the PET to take that byte off the bus.

The sequence of events involved in transfer of data on the IEEE is:

1. Set DAV high.

2. Check NRFD and NDAC to see if both are high (which is an error condition).

3. Put data on the bus and wait for NRFD to go high.

4. Set DAV low (and keep it low either until NDAC goes high or 900 usec have elapsed—more on this later.

5. Set DAV high.

6. Repeat the procedure for *each* piece of data, including commands (for addresses and commands step "set ATN low" would occur between 2 and 3 above).

This sequence is diagrammed in Fig. 3.

Interface Design

Armed with this information and with the interface requirements for the Centronics 101A printer, I was ready (I thought!) to begin the design of the interface.

The first item of note was that the PET data is "low-true"; that means that a low voltage state constitutes a 1 on the data line, and a high voltage represents a 0. Unfortunately, the Centronics expects the opposite to be the case; so I am already in need of two ICs just to invert these data lines. I chose 7404s for a simple reason: I had a couple of them! As it turned out, the spare sections of these could be used elsewhere in the circuit.

I discovered that while the PET was expecting a high on NRFD to indicate that the printer could accept another byte, the printer was producing a low-going signal; this used up one of those spare sections of the 7404 chips. But I discovered that the data-accepted line of the Centronics had the proper polarity without inversion!

All that remained (I thought!) was to take care of the ATN line to ensure that the printer only received printable characters and not addresses. In fact, that is what the logic of the circuit is all about: "DATA VALID AND NOT ATTENTION." I inverted the DAV line and then used that as one input to a 2-input NAND (7400), the other input being the ATN line. The output of the 7400 is then used as the data strobe to the printer. It gives a "data valid" strobe only when data valid (DAV) is true and attention (ATN) is false.

The circuit was constructed on a general-purpose PC board I obtained from International Electronics Unlimited, with sockets being used for the three ICs; I do *not* like to solder on ICs, having had several bad experiences with that procedure.

Well, the parts were soldered, the plugs were plugged and the Centronics printed. But what it printed was not familiar; it certainly didn't look like any language I had ever seen! Oh well, back to the good old phone; GTE at least made something off this experience.

I talked with several engineers again to try to decipher what was happening. When I described my circuit they were surprised that anything was being printed at all. You remember that I am only producing a data strobe signal when attention is false. Well, it turns out that the printer only produces a "data accepted signal" after a data strobe is received, there is no other way for it to know that there is valid data on the bus.

I forgot that the PET still places the addresses and commands on the bus before *each* character and expects a "data accepted" after *each* of these bytes are produced. It took me two weeks to realize this—many thanks to Rich Rosner of Connecticut Microcomputer for straightening me out.

This is a case of the PET's not really corresponding to IEEE protocol. If all the IEEE criteria were met by this machine, any data byte placed on the bus would stay there until the PET received acknowledgement that it was accepted. The PET does *not* wait; if the data is not accepted after a period of time (which looks like nearly a millisecond on our scope), it takes off that byte and places another one on the bus anyway.

After several more days of wondering, I called Rich Rosner again; he has probably forgotten more about the PET than Commodore ever knew. Seriously, he is the *only* person I have talked to who really knew how the PET worked; no one at Commodore could answer my questions. The solution to my dilemma was really his idea.

The Solution

There is no way the Centronics can generate a data-

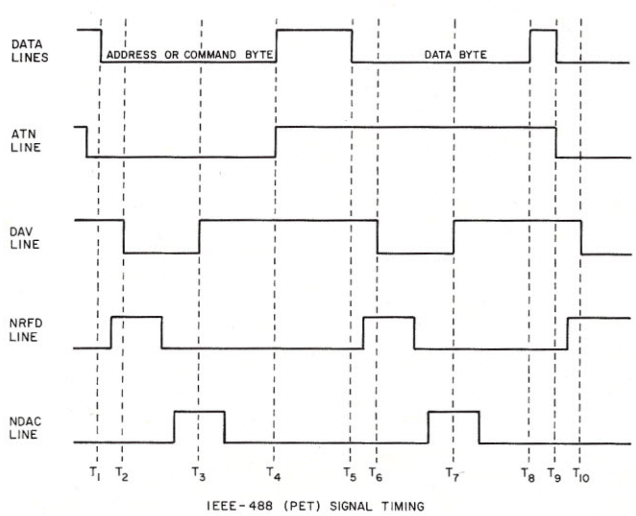
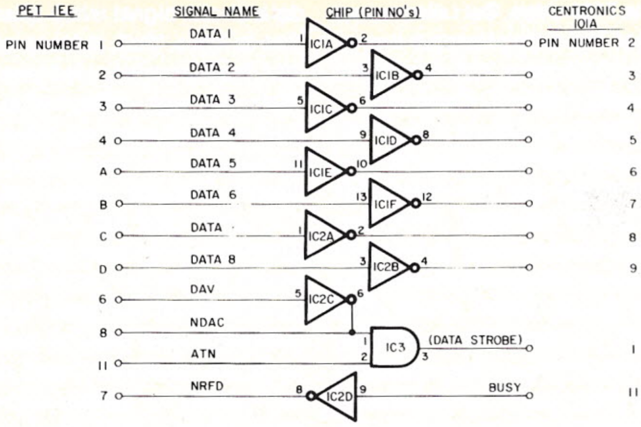


Fig. 3.



NOTES: A. PIN 14 ON CENTRONICS IS GND., SHOULD BE CONNECTED TO PET GND PINS

B. IC1 = IC2 = 7404; IC3 = 7400; PIN 7 = GND; PIN 14 = +5 VDC

C. PET IEE GND PINS USED ARE PIN 12 (CHASSIS GND) AND PIN N (DATA GND)

Fig. 4.

accepted pulse until and unless it has received a data strobe pulse. Since the PET requires this pulse, which the printer is unable to provide, we must help the PET to produce it. What I have done is invert the signal coming from DAV and route it back into NDAC; I don't use the acknowledge line from the printer at all.

This arrangement seems to work quite well; at least the printer runs at its full-rated speed now and does not print garbage. Additionally, the signal timing looks much better on the scope; DAV is now more on the order of a pulse instead of a level. (I thought for a while that this long duration of DAV was the cause of the printing difficulty, but it turned out to be a symptom of the underlying cause.)

The actual schematic for the final circuit is shown in Fig. 4, and the parts list appears as Fig. 5. I took the +5 volts from the printer, since my documentation for the printer was more complete. I *knew* that the power supply in the Centronics would not grunt with this additional load placed upon it. I simply did not have enough data on the PET's power supply to be willing to chance it. I was running a cable to the printer anyway, so why not steal power from it!

A. Open a file to write to; although this interface will accept any device number, I use device number five. This statement may look like

```
10 OPEN 5,5,1
```

and must appear in your program before you attempt to print anything on the printer.

B. Any printable output must be handled as though you are printing to a data file, such as:

```
20 PRINT#5, B$
```

C. Don't forget to close the file when you're done with the statement:

```
9999 CLOSE5
```

To list a program, type in command mode:

```
OPEN 5,5,1
CMD 5
LIST
```

After your program has been listed, type "CLR" and hit the return key to return to normal operation.

Incidentally, the print-tab function is *not* handled in this circuit. Apparently, this is output as a cursor-right and not as a space character. Ideas, anyone?

Table 1. To print to the IEEE from BASIC.

That's it, folks, a parallel printer interface for the PET for $10, with the most costly part being the plug needed for the Centronics. It works . . . unless you also want lowercase on output, and that's a whole 'nuther story. ■

ICs A and B. 7404
IC C. 7400
IC sockets, TI low-profile (3)
"IC Breadboard" . . . a general-purpose PC board available through International Electronics Unlimited.
Amphenol connector for the printer
Edge connector for the PET (Cinch#251-12-30-160)

Fig. 5. Parts list.

A BASIC Dollar Edit $ubroutine

If your version of BASIC does not provide for field editing, this may be for you.

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Like many users of small computers, I have often looked longingly at the more sophisticated versions of BASIC that provide a "PRINT USING" command for field editing. In order to use a language within a business environment, some editing and column alignment control are almost mandatory. It was with this in mind that I wrote the following routine. If you have a version of BASIC such as mine (SWTP 8K) that does not provide for field editing, then this program may be for you.

To use this routine your version of BASIC must have the string-data feature. In addition, the LEFT$, LEN, RIGHT$, STR$ and TAB functions must be available. Without the above, this routine cannot be used.

The Program

In the program listing, the initial section, lines 10 through 200, simply provides a means to demonstrate the use of the dollar edit subroutine. First, within this section, a heading is printed by lines 60 through 100. Since a heading is normally included on a report, this will provide an actual example of column alignment.

Following the heading, a FOR-NEXT loop is executed. This execution occurs a total of four iterations, thus providing the same number of detail lines for the example. Note that the detail lines are column-aligned under the headings (Example 1). The data for these detail lines are contained in lines 50 through 56. Specifically, through the execution of the READ statement in line 120, line 50 provides the data in the first detail line and line 52 provides the data for the second detail line, etc.

The statements that perform the editing within the FOR-NEXT loop are lines 130, 150 and 170. First, a statement loads the numeric variable Z with the value for which editing is desired. Immediately following is the execution of the edit subroutine.

The edit subroutine returns two variables: One is the numeric variable Z and the other is string variable Z$. The numeric variable Z, which initially carried the value to be edited, is reused and contains the number of characters, including symbols, within the string variable Z$. The string variable Z$ contains the actual edited field for printing. The initial values contained within the variables A, B and C are left unchanged.

The use of the numeric variable Z is to provide correct spacing of the edited field for column alignment. Since the headings end in columns 21, 36 and 51, it stands to reason that the detail line data fields should also end in these columns. The TAB function is used to accomplish this alignment. Once the ending position of a field is determined, then the variable Z is subtracted from it and the TAB function is executed using this result. Following the TAB function, the edited words are printed. Lines 140, 160 and 180 provide examples.

Dollar Edit Routine

The section of the program listing that contains the statements to actually accomplish the editing is composed of lines 2000 through 2200. The coding is presented in subroutine form in the same manner that would normally be found in a program. This allows the routine to be reused, thereby effectively reducing program size.

The first step in this routine is to round the incoming value contained in the numeric variable Z to two decimal points (lines 2010 and 2020). In terms of dollars, this means the value is rounded to the nearest cent. The rounded value is then moved into the string variable Z$ by the use of the STR$ function in line 2030. This allows the nonnumeric edit symbols, such as the dollar sign and comma, to be inserted into the correct locations of the incoming field through string-concatenation operations.

In the first string-concatenation operation, the dollar-sign-edit symbol is added to Z$ in line 2040. Then the decimal point is adjusted, if required, to two digits or cents in lines 2050 through 2100. This is to ensure that a period and two numeric digits will print as the three right-most characters within the edited field. This is a must for decimal-point column alignment.

For this operation, line 2050 computes the length of the edit field, and if it contains two characters or less, it automatically assumes the need for a period and two zeros. This is accomplished by the branch to line 2100. Keep in mind that one character of the edit field is the

```
          FIELD # 1      FIELD # 2      FIELD # 3
         $10,000.00      $5,000.00        $200.20
              $1.00          $0.05          $0.10
        $100,000.00         $25.46         $10.00
            $100.01         $47.98          $0.00
```

Example 1.

```
#2040
#2050Z=LEN(Z$) : IF Z<= 1 THEN 2100
#2060
#2120IF Z < 7 THEN 2200
#


#RUN


             FIELD # 1      FIELD # 2      FIELD # 3
             10,000.00       5,000.00         200.20
                  1.00           0.05           0.10
            100,000.00          25.46          10.00
                100.01          47.98           0.00

READY
#
```

Example 2.

dollar sign, and the second character is a significant number. If the length of the edit field is greater than two, then line 2055 will move the right-most three characters of the edit field into the string variable Y$. This will allow comparisons to be made on just those three characters.

The first comparison at line 2060 will match the characters just moved into Y$ to the literal "$99." Since the hex value of a dollar sign is less than the hex value of a period, a true condition signals the need for further analysis, which will occur starting at line 2080. A false condition falls through to the next comparison at line 2070, where the characters in Y$ are matched to the literal ".99." If the edit field is already decimal-point aligned, the literal value will be the largest that can be contained in those three digits; thus, a true condition results in the determination that no adjustment is required. So a branch to line 2120 will occur.

If further analysis is required, based on the comparison in line 2060 or in line 2070, then line 2080 will move the right-most two characters of the edit field into the string variable Y$. Again, this is to allow a comparison on just those two characters. The comparison at line 2090 will match the value that is in Y$ to the literal ".9."

At this point, this is the largest value that can be contained in those two digits, if a decimal point and one digit are present. A true condition will result in the addition of one zero also in line 2090. A false condition results in the addition of a period and two zeros in line 2100. We have now completed the decimal-point adjustment.

The LEN function is used in line 2110 to compute the length of the edit field. If the edit field is less than eight characters (including edit characters), a comma will not be required. This comparison is made at line 2120, and a true condition results in a branch to the subroutine return at line 2200. If a comma is required (length of eight characters or more), it is performed by lines 2130 through 2150.

Inserting the Comma

To add the comma, the right-most six characters of Z$ are moved into the string variable Y$ in line 2130. A comma is then added by string concatenation to the left of the data contained in Y$ in line 2140. Finally, in line 2150 the remaining left-most characters of Z$ are added to the left side of Y$, thus completing the edited field. Since a comma was added, the updated Y$ is moved back into Z$ for the return, and the length of the edited field is adjusted by one in line 2170.

This routine was initially designed to edit values no larger than six significant digits. If editing for larger values is desired, the routine can be expanded after line 2170. The addition of another comma would require a similar technique to that used in lines 2130 through 2150.

The routine may also be modified to edit without the addition of a dollar sign. To accomplish this, remove line 2040, then change the comparison value in line 2050 to a one. Line 2060 should also be removed, and, finally, the comparison value in line 2120 should be changed to a seven (Example 2).

I have used this routine with success in several programs, including a loan amortization program. If you have a need for this type of field printing and column alignment, give this routine a try. ■

```
0010 REM
0020 REM DOLLAR EDIT ROUTINE EXAMPLE PROGRAM
0030 REM WRITTEN BY M DONAHUE 1979
0035 REM
0040 LINE= 0
0050 DATA 10000, 5000.0049, 200.204999
0052 DATA 1, .051, .1
0054 DATA 100000, 25.455, 10
0056 DATA 100.005, 47.978, 0
0058 REM '  HEADING FOR THE EXAMPLE
0060 PRINT
0070 PRINT
0075 PRINT
0080 PRINT TAB(12);"FIELD # 1";
0090 PRINT TAB(27);"FIELD # 2";
0100 PRINT TAB(42);"FIELD # 3"
0105 REM '  LOOP TO PRINT THE EXAMPLE DETAIL LINE AND
0106 REM '   DEMONSTRATE THE USE OF SPACING WITHIN THE LINE
0110 FOR Q=1 TO 4
0120 READ A, B, C
0130  Z=A : GOSUB 2000
0140 PRINT TAB(21-Z);Z$;
0150  Z=B : GOSUB 2000
0160 PRINT TAB(36-Z);Z$;
0170  Z=C : GOSUB 2000
0180 PRINT TAB(51-Z);Z$
0190 NEXT Q
0200 END
1980 REM
1990 REM
2000 REM *** DOLLAR EDIT ROUTINE ***
2002 REM
2004 REM VARIABLE "Z" CONTAINS VALUE TO BE EDITED BY ROUTINE
2006 REM
2008 REM '  2010-2020 ROUNDS NUMBER TO 2 DECIMAL POINTS
2010 IF (100*Z-INT(100*Z))<.5 THEN Z=INT(100*Z)/100 : GOTO 2030
2020  Z=(INT(100*Z)+1)/100
2025 REM '  MOVE NUMERIC TO STRING VARIABLE
2030  Z$=STR$(Z)
2035 REM '  ADDS DOLLAR SIGN
2040  Z$ = "$"+Z$
2045 REM '  2050-2100 ADJUSTS DECIMAL POINT (IF REQUIRED)
2050  Z=LEN(Z$) : IF Z <= 2 THEN 2100
2055  Y$=RIGHT$(Z$,3)
2060 IF Y$ <="$99" THEN 2080
2070 IF Y$ <=".99" THEN 2120
2080  Y$=RIGHT$(Z$,2)
2090 IF Y$ <=".9" THEN Z$=Z$+"0" : GOTO 2110
2100  Z$=Z$+".00"
2105 REM '  2110-2150 ADDS COMMA (IF REQUIRED)
2110  Z=LEN(Z$)
2120 IF Z < 8 THEN 2200
2130  Y$=RIGHT$(Z$,6)
2140  Y$=","+Y$
2150  Y$=LEFT$(Z$,(Z-6))+Y$
2155 REM '  Z$ WILL CONTAIN EDITED FIELD
2160  Z$=Y$
2165 REM '  Z WILL CONTAIN THE LENGTH OF THE EDITED FIELD
2170  Z=Z+1
2200 RETURN
```

Program listing.

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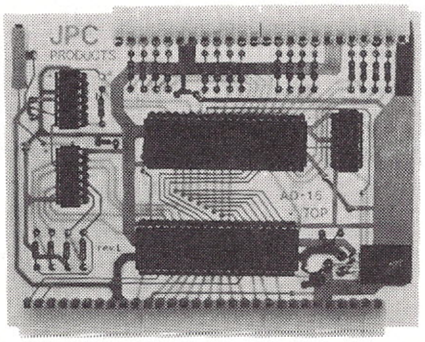

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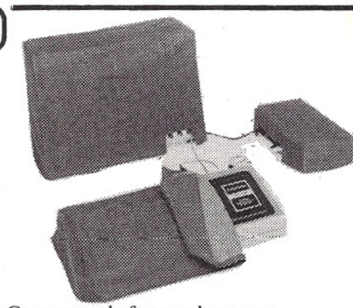

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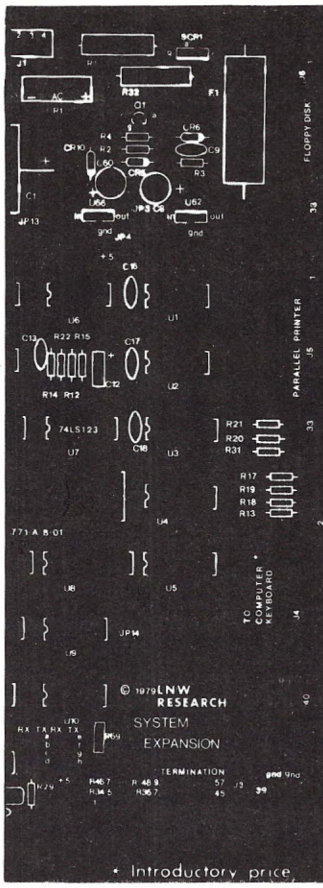

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How to Build a Word Processor

This 6800-based system was assembled from available hardware and software products.

Many articles in the hobby press have described various components of word-processing systems. However, to my knowledge, none has described an integrated system, complete with hardware, software, all system interfaces and a high-quality impact printer at the lowest possible cost and the least possible fuss.

As a schoolteacher, my wife, Mary Ellen, frequently uses the home word-processing center for classroom planning. In the left foreground is the COPE-1030 printer, with paper coming off the tractor feed. Mary Ellen's right hand is at the keyboard of the ADM-3A terminal. Between her right hand the bookcase is the SWTP 6800 computer. The entire word-processing system takes up less room than many stereo systems.

This article describes a 6800-based system, complete with all hardware and software interfaces, using a Selectric-based I/O printer. Most of the components used here have been described before, but not as an integrated system. So I will only discuss those aspects of each component as it relates to the system as a word processor.

The System

If you need a high-quality word-processing system at low cost, or if you already own an SWTP 6800 computer and would like to integrate it into a quality word processor, this article is for you. If you own an 8080-based system and would like to do quality word processing, then this article can help.

I knew two years ago, when I bought my SWTP 6800 system, that I wanted to use it for word processing. And I wanted high-quality hard-copy output from an impact printer, preferably based on the Selectric mechanism. So, on the same day that I bought the SWTP computer at The Micro Store in Richardson (Dallas), I bought a COPE-1030 Selectric I/O terminal at the Rondure Company, also in Dallas.

I expected interfacing to pose some problems, but it turned out to be absolutely painless. And the nice part is that everything is off-the-shelf. There is absolutely *no* haywiring required. And here's an added bonus: In a pinch, you can use the Selectric for input. The software driver described here provides full handshaking between the Selectric terminal and the computer (more on this later).

Here are the main system components:

1. SWTP 6800 computer system with AC-30 interface and 20K of programmable memory.
2. Lear Siegler ADM-3A Dumb Terminal.
3. COPE-1030 I/O Terminal (IBM heavy-duty mechanics).
4. Computerware software driver for Selectric in EPROM.
5. Percom Data Co. LFD-400 single floppy-disk system.
6. Percom TOUCHUP software, used in conjunction with Technical Systems Consultants' Text Editor/Processor package.

The COPE-1030 I/O Terminal

Since the characteristics of the COPE-1030 place constraints on the rest of the system, I will describe it first.

The first important characteristic of the COPE-1030 is its price. It is inexpensive, that is to say, it is low-cost, but decidedly *not* cheap. In shopping around for Selectric-based terminals, you will find them ad-

vertised for anywhere from $895 (used, modified or reconditioned) to $2600. The COPE-1030 costs between $295 and $695 at current prices.

Usually, the 1030 is advertised in one of three conditions: (1) "as-is" (you take your chances); (2) used, but working; (3) refurbished. The price increases about $100-$200 as you move from one version to the next. Mine was "used, but working." At the then-prevailing price, I saved $200. And I haven't regretted it, although the refurbished models did look a lot better than mine.

Since the COPE-1030 was originally a computer terminal, it comes with all of the electronics built in to provide RS-232 serial interface with the outside world, on the one hand, and to drive the Selectric magnets, on the other. It comes complete with an RS-232 connector built in. Mine even came with an acoustic coupler and modem for use over telephone circuits. You can even get a tractor feed for $50 (they cost $176 new).

Having all of the electronics built in does save a lot of trouble. I've seen articles on how to interface the Selectric with microcomputers, including how to build and interface the magnet drivers. None of that with the 1030—you just run three wires from the RS-232 connector of the 1030 to the RS-232 connector of your micro. There is one small hitch, however: The 1030 and the 6800 don't speak the same language.

The 6800 speaks and understands ASCII, while the 1030 speaks in one of the IBM codes (either Correspondence or EBCDIC). As near as I can tell, there is no reason to prefer one code over the other. It was only by chance, therefore, that I got the Correspondence version, and I can't tell that it makes any difference. They are the same price. In any event, since the 6800 and the 1030 don't speak the same language, there must be some means of translating. And that's where Paul Searby of Computerware comes in.

The Software Driver

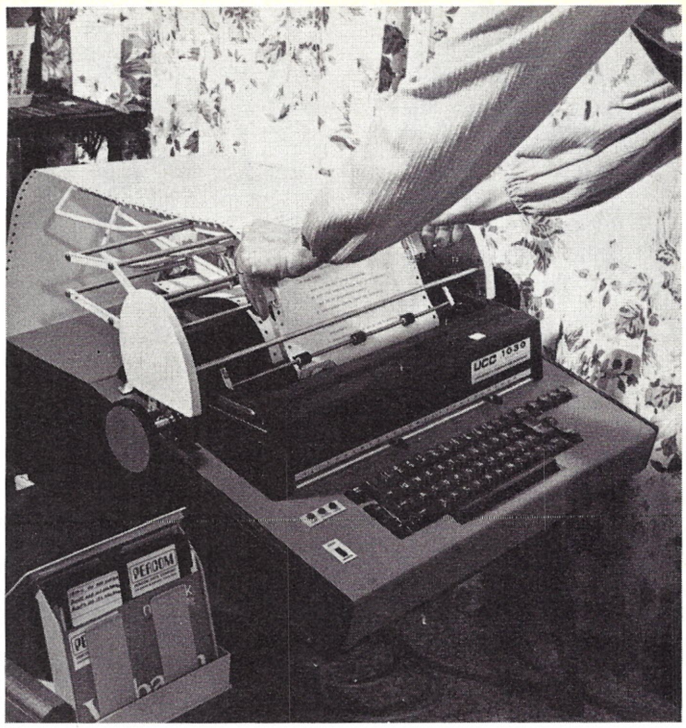
Two years ago, when I bought the major components of my system, the usual method of translating was to obtain a used terminal of some kind, strip it down and add the necessary relays, electronics, etc., and then write a software driver to make it go. I thought I would have to do the same. But I got away from developing the system for one reason or another. And then when I did get back to it, I found that all of the hard work had been done for me by Paul Searby of Computerware, in Encinitas, California.

Paul has developed two versions of the software driver for the COPE-1030. Which version you need depends on which version of the SWTP 6800 system you have. If your system has the older MP/A microprocessor board, then you will need the RC-68 version of Paul's software driver, which comes in an EPROM and requires some minor modifications to the CPU board.

I had the older board, but after reading a review of the newer, MPA/2 board in *Kilobaud*, I decided to buy the new board. The bare board cost me $14.50 from The Micro Store. After spending about another $20 for new integrated circuits, I was ready to go. So I bought the 2716 EPROM version of the Selectric driver. Here's how it works.

When you order your Selectric driver from Paul, you have to tell him which version of the SWTP computer you have, whether your keyboard is Correspondence or EBCDIC and which typeface and monitor you prefer. As for typeface, the ASCII is a good choice. But in any event, you can get the one you want from IBM for $18.

When he burns the EPROM, Paul will burn it co-resident with the monitor that you specify. Then you no longer need your old monitor plugged into the CPU board. For example, the RC-68 version plugs into the socket that you had MIKBUG plugged into when you bought it. In my case, I ordered the 2716 EPROM version with MIKBUG, since I was used to it and didn't want to try two new things at the same time. I have another



COPE-1030 in action. Although the tractor-feed mechanism looks formidable, it actually goes on or off in less than five minutes. Cost is about $50 (used). Ribbons for the COPE-1030 are readily available at most office-supply houses for about $2 (Marathon Selectric #72 black standard fabric in throwaway cartridge). Tractor-feed paper is inexpensive—about $19 for 3000 sheets (8 1/2 × 11 inches). The COPE-1030 uses standard IBM Selectric typefaces. Author uses the ASCII style (part no. 01167168), which costs about $19 each from IBM. Incidentally, if you don't like the case style, you can purchase a stylish office case at nominal cost.

on order now, with SMARTBUG and output to port 7. Unless you specify otherwise, Paul will configure the Selectric driver with output to an MP-S serial interface card on port 3 (more about this later).

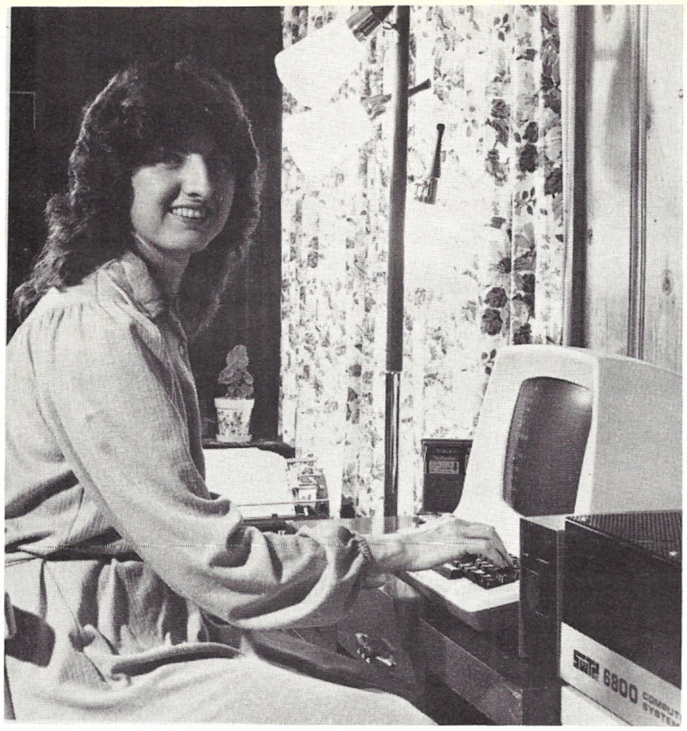
When you buy the Selectric driver, Paul includes the complete source listing. I feel that this is one practice that should be encouraged to the limit, since it is nearly impossible to work on a system without full software documentation. The Selectric driver is copyrighted, and Paul asked that the source listing not be printed. So I have not included it here.

Using the Selectric driver is the essence of simplicity. Just plug it into socket 23, set DIP switch number 7 on, and you're ready. Incidentally, do not place DIP switch number 5 in the on position. I followed what I thought was a pretty reliable source (not Computerware) and put number 5 on. Three weeks later, after lengthy troubleshooting procedures, I found that switch 5 should be off.

If your main interest in the Selectric is word processing, then it will probably be a rare occasion when you will want to use it for input. But in a pinch it does come in quite handy, if you have that capability. That's what makes the Computerware driver so nice. As an extra, you get I/O capability with full handshaking.

I mentioned earlier that the characteristics of the COPE-1030 determine what you have to do to the rest of the system to make it functional. One of its characteristics that must be considered is its 134.5 baud rate. Now don't panic . . . this doesn't complicate things at all. The MC14411 baud rate generator in the SWTP 6800 system already has the 134.5 baud rate as an output; they just don't tell you. Here's how you get to it.

Pin 14 of the MC14411 is the output for the 134.5 baud rate. Pin 8 outputs the 150 baud rate.



The SWTP 6800 computer in the extreme right foreground, with the LFD-400 single floppy disk drive between it and the ADM-3A video terminal. In the background at left center is the COPE-1030 printer. Note that if you have an 8080-based computer instead of the 6800, you can still use the COPE-1030 and the TSC editor/processor and your own disk drive. The Rondure Company sells an assembled and commented software driver program for the 8080. You can have it stored in either EPROM or disk, since it only takes a few hundred bytes.

As sent from the factory, pin 14 is not used. The pad is there, but the signal isn't routed anywhere. You probably aren't using the 150 baud rate anyhow, so cut the land from pin 8 and run a jumper from pin 14 to the land that you just separated from pin 8. You now have 134.5 baud being sent out over the lines marked 150b. It takes about three minutes if you use an X-acto knife, fine solder and fine wire. That's it.

That's all there is to using Computerware's Selectric driver. Just plug the 2716 EPROM into socket 23, do the jumpering between the pins of the MC 14411, run three wires from the serial RS-232 port on your 6800 to the RS-232 connector of the COPE-1030, and you're in business. All you need now is a disk drive and the special software for word processing. That's where Percom Data Co., of Garland (Dallas), Texas, comes in.

LFD-400 and TOUCHUP

If you've ever called a company and asked to speak with a sales engineer, only to be told that they're all too busy, then you will really appreciate Harold Mauch and the other folks at Percom Data. They have always taken the time to answer my questions and to give any help that they could—both before *and* after the sale. That was my *first* reason for choosing Percom.

The second was the location. They were close enough for me to visit and get a first-hand demonstration of the system's capabilities. The third consideration was that I could get a system with only one drive and later expand it to a dual or triple drive system as need and finances permitted. As it turned out, I got the single drive system.

The Percom LFD-400 single drive system is a nice way to get into word processing without being eaten alive by the cost. You have three choices of operating systems. The first is MINIDOS, a primitive system that requires you to call up files by drive and sector number. In other words, MINIDOS doesn't permit named files.

The second possibility is MINIDOS-PLUS. It does permit named files, which is a real convenience. Both MINIDOS and MINIDOS-PLUS are in EPROM. The third possibility is INDEX, a disk-based operating system. I got the MINIDOS-PLUS version. But if you are using the system strictly for word processing, then you really don't need to spend the extra bucks for the MINIDOS-PLUS named-file feature.

When you buy the Percom system, you have the choice of single, dual or triple disk drives. You also have the choice of either Shugart or Pertec drives. As I understand it, the two are almost identical, except for one thing: The Pertec drives permit you to use *both* sides of the diskette simply by turning it over and reinserting it into the drive.

Each side of the diskette has a capacity of about 100K bytes. With an overhead of about 10 percent for supporting the operating system, that leaves a total of about 180K capacity per disk. Although you do not have that much capacity available and on line, it is sufficient.

In order to use the LFD-400 with your SWTP 6800 system, you need to make some minor modifications to the system. First, you need to replace the two-prong ac line cord with one having the third prong for safety reasons.

Next, you need to locate at least 4K of memory starting at address $A000. If you have the newer A2 board, it means that you only have to modify the memory card. If you have the older MP/A board, you must make a couple of minor jumper mods to it. Percom gives full instructions.

Last, if you have the MPA/2 board, then you really need to replace the RC network for the baud rate generator circuit with a 4 MHz crystal (from Jameco Electronics). That takes care of the hardware considerations for the system, which brings us to the software.

The folks at Percom have developed a set of software overlays to be used with the Technical Systems Consultants' text editor and processor. It's called TOUCHUP. The TSC editor and processor commands make the pair into a versatile word-processing software system. But the additional commands and features of TOUCHUP prove really invaluable. For example, TOUCHUP makes it possible to edit in-line, to add, delete or otherwise modify within the line itself.

Another valuable feature of TOUCHUP is the ROLL command, which makes it possible for you to create and edit files of text many times larger than your available memory. The ROLL command literally creates a software spool so that you can roll the file out of the edit buffer into disk a hundred lines or so at a time. If you happen to have, say, 8K of available memory and a file of text on disk that would occupy, say, 15K, here's what you do.

Suppose that you have the text stored on disk starting at sector 10 and you want to edit it and store the edited copy starting at sector 100. You might give this command:

```
IN 1010:OUT 1100:READ 100
```

This would open the input file at sector 10, open the output file at sector 100 and read 100 lines of text into the editor.

After editing the copy and having it ready for output, you might give this command:

```
T:ROLL 100
```

This would output the first 100 lines to the disk and read in a new 100 lines to be edited. Continue until the entire file is finished.

After the last text has been written to disk, you would finish with an END command to put an end-of-file mark at the end of the text and to close the files. The T indicates that you placed the file in top-to-bottom order before writing to disk. Otherwise, you could end up with the text written to disk backwards.

There are many features of the processing system that you will learn only by frequently using it. But it is amazing how quickly you will learn. The sys-

tem fools you into thinking that you're bright. But the truth is that those folks who originated the editor/processor software were the bright ones. The processor permits even a novice to do versatile formatting after only a couple of sessions. For example, the header and footer macros alone are worth the price of the software. Then when you throw in features such as the editing commands, the other commands from TOUCHUP and the ease of writing made possible with the system, the software is enhanced.

One feature was missing in the original version of TOUCHUP: the back-space command. Naturally, if you're going to underline a word or section of text, the system needs to be able to respond to a back-space command. Percom's software consultant, Jim Stutsman, fixed it for me by providing a software patch assigning a special character to the back-space function to be recognized by the COPE-1030.

This feature cost me $25, since it had to be developed from scratch. However, it should be available to future users at a nominal cost. That was the last detail as far as I was concerned. As it now functions, the word-processing system is extremely flexible.

That essentially covers the entire word-processing system. I haven't dwelt on costs since prices on the things I've discussed are usually advertised in *Microcomputing*. Also, the final price that you will end up paying for your system will depend on how you have it configured.

For example, if you use the SWTP CT-64 terminal, your system cost will be different than mine, since I have the ADM-3A. Also, if you already have the SWTP disk system or the one from Smoke Signal Broadcasting, then your costs will be different and your approach to final system hookup will change.

The point is that there is a lot of room for variation. What I've outlined here is a total, integrated system that works superbly to give the best possible performance with the least fuss at the lowest price. I've used it for about six months now and have no complaints. To me, the acid test comes with your answer to this question: "Knowing what you do now, if you had it to do over again, what would you do?" My answer to that question is that I wouldn't change a thing.

So, if word processing is your bag, take some of the ideas outlined here and do it the easy way. ■

Happy Thanksgiving.

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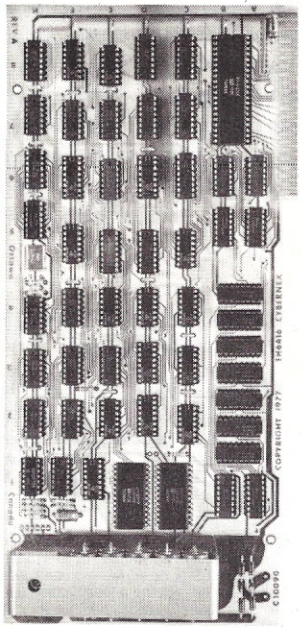

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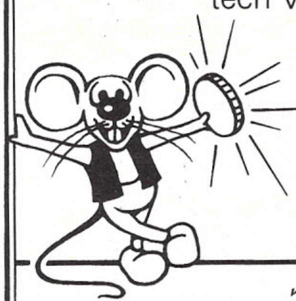

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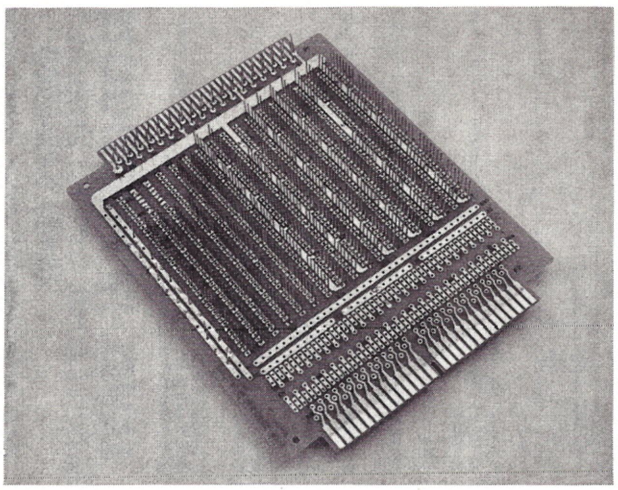

Photo 1. Typical bare, high-density wire-wrap board.

As anyone who has attempted construction of a microprocessor or other large-scale digital project knows, wire-wrapping has tremendous advantages over conventional wiring techniques. The ease of modification and correction of mistakes is a distinct advantage. However, after you wire-wrap for an hour or more it becomes nearly impossible to tell which pin is which, much less which socket is which.

With high-density boards as shown in Photo 1, it is not easy to find the right socket, and the pin rows can be mistakenly interchanged, pin 1 being mistaken for pin 16. Photo 2 illustrates a solution we have adopted which eliminates the problem. Short pieces of insulated tubing, 15 to 25 mm long, are slipped over pin 1 of each socket. Now it is both easy to locate each socket and

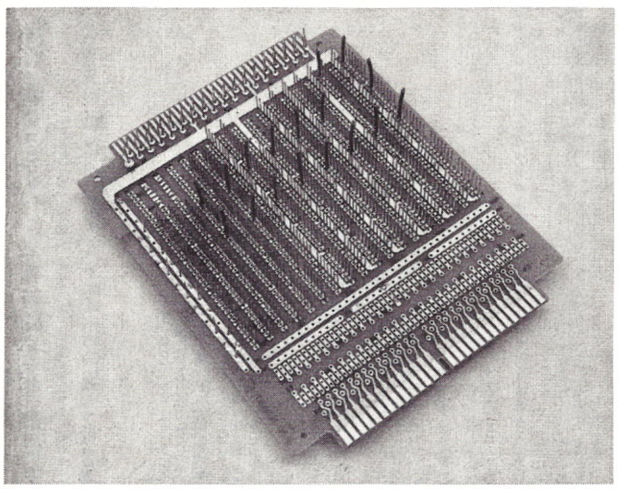

Photo 2. Tubing marking pin 1 of several sockets.

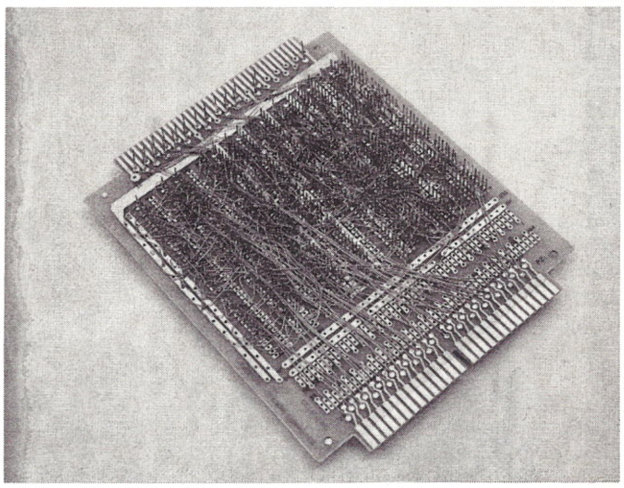

Photo 3. Typical completed high-density board.

determine the pin orientation.

The technique was so successful that other applications became apparent. Photo 3 shows a completed wire-wrap board to which we needed to add or change three wires. Longer pieces of tubing were routed from each wire's source to its corresponding destination. Then with wire in hand, we lifted the source end of the tubing and wrapped the wire to the pin. The wires were then routed to their respective destination pins, where the tubing was removed and the connection completed.

The tubing is easy to see and prevents confusion, as shown in Photo 4. Another application is to mark and isolate test points by placing short pieces of the tubing on the pin or pins immediately adjacent to the pin you want to monitor. This serves two functions. First, the test point is now easy to find, and, second, the adjacent pin or pins are insulated, permitting a clip lead to be connected to the test point without shorting to the other pins.

These simple applications of tubing make wire-wrapping projects quicker, and fewer errors are made. The technique also reduces eyestrain, permitting longer periods of continuous work. ■

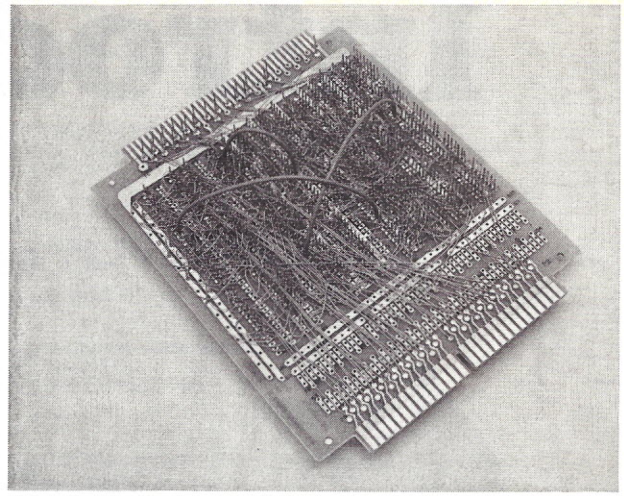

Photo 4. Tubing "jumpers" showing wire routes.

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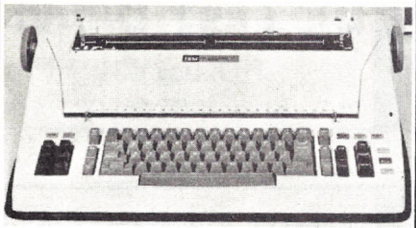

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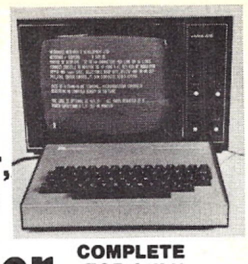

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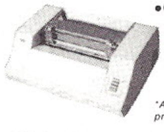

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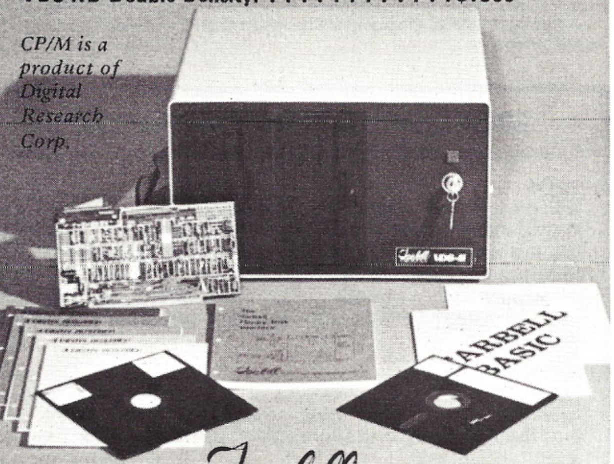

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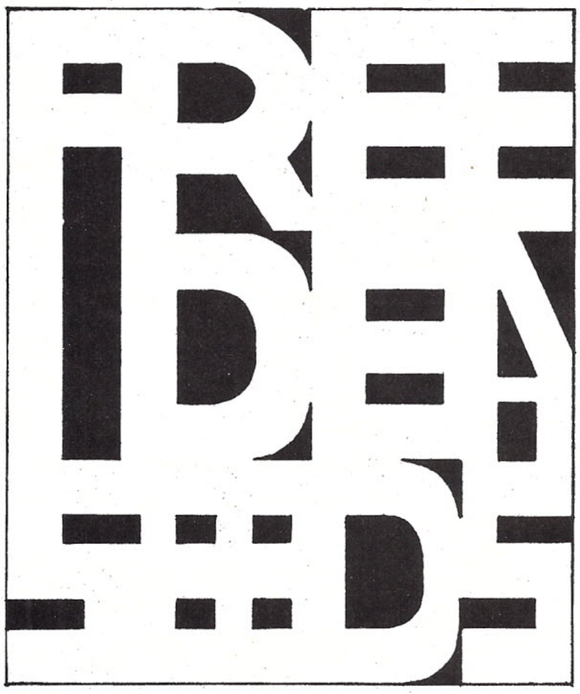

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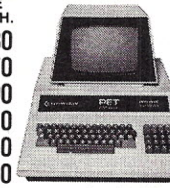

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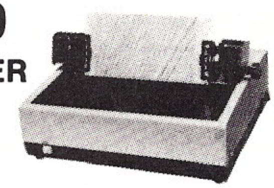

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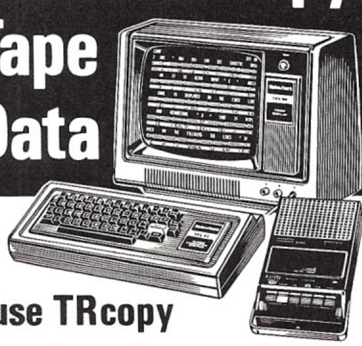

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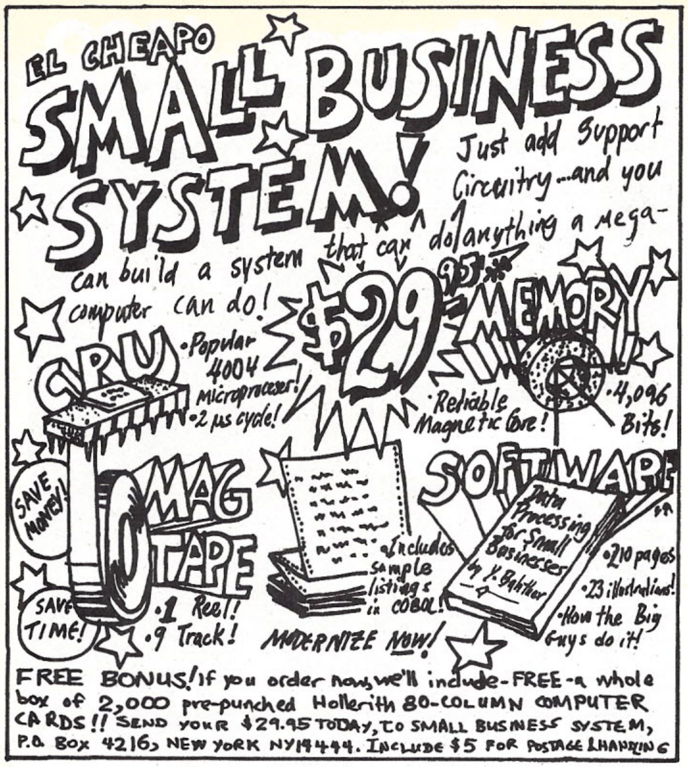
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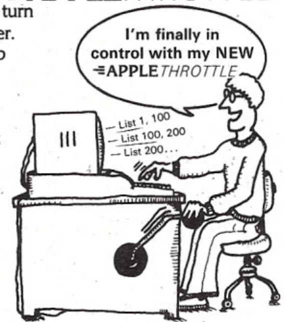

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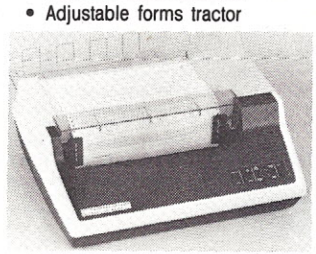

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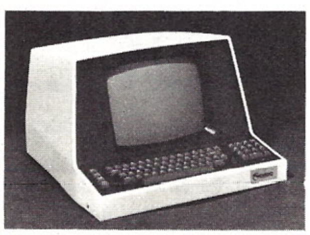

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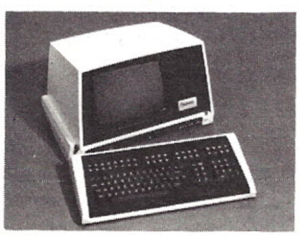

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ELF II has been designed to play all the video games you want, including a fascinating new target/missile gun game that was developed specifically for ELF II. But games are only the icing on the cake. The real value of ELF II is that it gives you a chance to write machine language programs—and machine language is the fundamental language of all computers. Of course, machine language is only a starting point. You can also program ELF II with assembly language and tiny BASIC. But ELF II's machine language capability gives you a chance to develop a working knowledge of computers that you can't get from running only pre-recorded tape cassettes.

ELF II Gives You The Power To Make Things Happen!

Expanded, ELF II can give you more power to make things happen in the real world than heavily advertised home computers that sell for a lot more money. Thanks to an ongoing committment to develop the RCA 1802 for home computer use, the ELF II products—being introduced by Netronics—keep you right on the outer fringe of today's small computer technology. It's a perfect computer for engineering, business, industrial, scientific and personal applications.

Plug in the **GIANT BOARD** to record and play back programs, edit and debug programs, communicate with remote devices and make things happen in the outside world. Add **Kluge** (prototyping) **Board** and you can use ELF II to solve special problems such as operating a complex alarm system or controlling a printing press. Add **4k RAM Boards** to write longer programs, store more information and solve more sophisticated problems.

ELF II add-ons already include the **ELF II Light Pen** and the amazing **ELF-BUG Monitor**—two extremely recent breakthroughs that have not yet been duplicated by any other manufacturer.

The ELF-BUG Monitor lets you debug programs with lightening speed because the key to debugging is to know what's inside the registers of the microprocessor. And, with the ELF-BUG Monitor, instead of single stepping through your programs, you can now display the entire contents of the registers on your TV screen. You find out immediately what's going on and can make any necessary changes.

The incredible ELF II Light Pen lets you write or draw anything you want on a TV screen with just a wave of the "magic wand." Netronics has also introduced the ELF II Color Graphics & Music System—more breakthroughs that ELF II owners were the first to enjoy!

ELF II Tiny BASIC

Ultimately, ELF II understands only machine language—the fundamental coding required by all computers. But, to simplify your relationship with ELF II, we've introduced an **ELF II Tiny BASIC** that makes communicating with ELF II a breeze.

Now Available! Text Editor, Assembler, Disassembler And A New Video Display Board!

The Text Editor gives you word processing ability and the ability to edit programs or text while it is displayed on your video monitor. Lines and characters may be quickly inserted, deleted or changed. Add a printer and ELF II can type letters for you—error free—plus print names and addresses from your mailing list!

ELF II's **Assembler** translates assembly language programs into hexidecimal machine code for ELF II use. The Assembler features mnemonic abbreviations rather than numerics so that the instructions on your programs are easier to read—this is a big help in catching errors.

ELF II's **Disassembler** takes machine code programs and produces assembly language source listings. This helps you understand the programs you are working with...and improve them when required.

The new **ELF II Video Display Board** lets you generate a sharp, professional 32 or 64 character by 16 line upper and lower case display on your TV screen or video monitor—dramatically improving your unexpanded $99.95 ELF II. When you get into longer programs, the Video Display Board is a real blessing!

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☐ **A-D/D-A Board Kit** includes 1 channel (expandable to 4) D-A, A-D converters, **$39.95** plus $2 postage & handling..

☐ **PILOT Language**—A *new* **text-oriented** language that allows you to write educational programs on ELF II with speed and ease! Write programs for games...unscrambling sentences...spelling drills..."fill in the missing word" tests, etc.! PILOT is a must for any ELF II owner with children. *PILOT Language on cassette tape, only $19.95 postpaid!*

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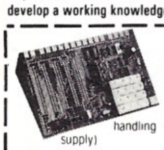

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☐ Tom Pittman's **Short Course On Microprocessor & Computer Programming** teaches you just about everything there is to know about ELF II or any RCA 1802 computer. Written in non-technical language, it's a learning breakthrough for engineers and laymen alike. $5 postpaid.

☐ Deluxe Metal Cabinet with plexiglas dust cover for ELF II, $29.95 plus $2.50 p&h.

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☐ **ELF II Tiny BASIC** on cassette tape. Commands include SAVE, LOAD, ±, ×, ÷, (), 26 variables A-Z, LET, IF/THEN, INPUT, PRINT, GO TO, GO SUB, RETURN, END, REM, CLEAR, LIST, RUN, PLOT, PEEK, POKE. Comes fully documented and includes alphanumeric generator required to display alphanumeric characters directly on your tv screen without additional hardware. Also plays tick-tack-toe plus a drawing game that uses ELF II's hex keyboard as a joystick. 4k memory required. **$14.95** postpaid.

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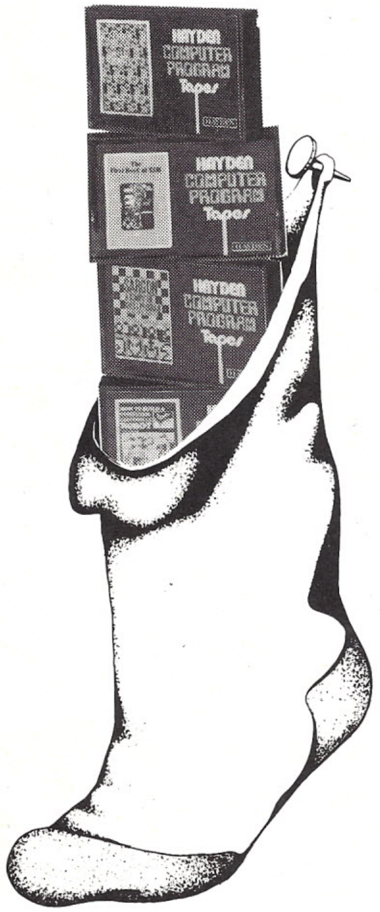

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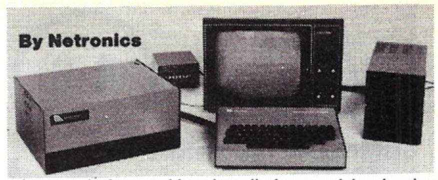

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Level "A" at $129.95 is a complete operating system, perfect for beginners, hobbiests, or industrial controller use.

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System Monitor (Terminal Version): 2k bytes of deluxe system monitor ROM located at F000 leaving 0000 free for user RAM/ROM. Features include tape load with labeling ...tape dump with labeling...examine/change contents of memory ...insert data...warm start...examine and change all registers...single step with register display at each break point, a debugging/training feature...go to execution address... move blocks of memory from one location to another...fill blocks of memory with a constant...display blocks of memory ...automatic baud rate selection...variable display line length control (1-255 characters/line)...channelized I/O monitor routine with 8-bit parallel output for high speed printer... serial console in and console out channel so that monitor can communicate with I/O ports.

System Monitor (Hex Version): Tape load with labeling... tape dump with labeling...examine/change contents of memory...insert data...warm start...examine and change all registers...single step with register display at each break point ...go to execution address. Level "A" in the *Hex Version* makes a perfect controller for industrial applications and can be programmed using the Netronics Hex Keypad/Display.

Hex Keypad/Display.

Hex Keypad/Display Specifications

Calculator type keypad with 24 system defined and 16 user defined keys. 6 digit calculator type display which displays full address plus data as well as register and status information.

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Level "B" provides the S-100 signals plus buffers/drivers to support up to six S-100 bus boards and includes: address decoding for onboard 4k RAM expansion select-able in 4k blocks...address decoding for onboard 8k EPROM expansion selectable in 8k blocks...address and data bus drivers for onboard expansion...wait state generator (jumper selectable), to allow the use of slower memories...two separate 5 volt regulators.

Explorer/85 with Level "C" card cage.

Level "C" Specifications

Level "C" expands Explorer's motherboard with a card cage, allowing you to plug up to six S-100 cards directly into the motherboard. Both cage and cards are neatly contained inside Explorer's deluxe steel cabinet. Level "C" includes a sheet metal superstructure, a 5-card gold plated S-100 extension PC board which plugs into the motherboard. Just add required number of S-100 connectors

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Level "D" provides 4k or RAM, power supply regulation, filtering decoupling components and sockets to expand your Explorer/85 memory to 4k (plus the original 256 bytes located in the 8155A). The static RAM can be located anywhere from 0000 to EFFF in 4k blocks.

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Level "E" adds sockets for 8k of EPROM to use the popular Intel 2716 or the TI 2516. It includes all sockets, power supply regulator, heat sink, filtering and decoupling components. Sockets may also be used for soon to be available RAM IC's (allowing for up to 12k of onboard RAM).

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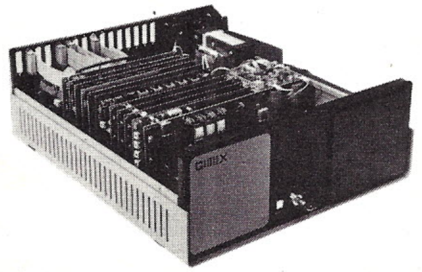

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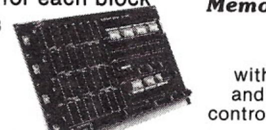

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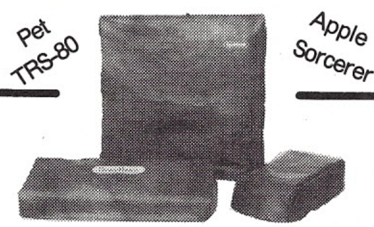

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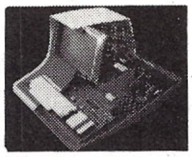

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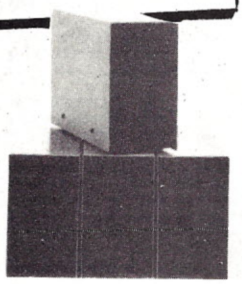

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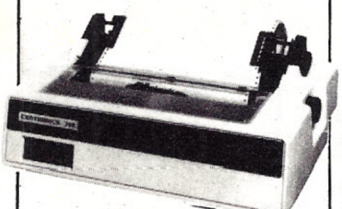

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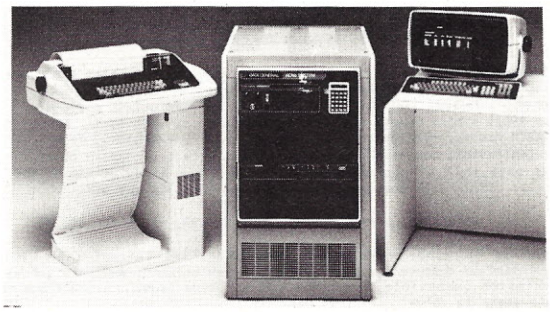

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CORRECTIONS

Address change: John Krutch, author of "Haiku Composer" (August 1979, p. 80), has moved. New address: PO Box 9284, Fort Worth TX 76107.

Also in the August issue: In Fig. 2 of "PET Wrap-up" (p. 112) by Tom Hayek, IC2 pin 8 should be pin 7, and IC2 pin 7 should be pin 6; on the connector at the control bus, NC should be N.

"Unfortunately, the $874 retail price on the Intertube ("A Look at Terminals," September 1979, p. 25) became obsolete in April 1979. The new price is now $995. Apparently, the information you had on file was received before the price increase. We would appreciate any assistance you would provide in correcting this minor error as we have received several complaints from our dealers who are selling the units at the new list price." —Intertec Data Systems, Columbia SC.

"In my article, 'Four More Commands for SSB DOS,' in the October 1979 issue, there is a problem with my use of the line input buffer that causes the command not to work with the new 5.0 version of DOS68. An updated listing of the command, which now locates hex and ASCII strings and is compatible with all versions of DOS68, is available from me for an SASE."—Terry Perdue, 1470 Wilson Rd., St. Joseph MI 49085.

"In reference to my article, 'Inventory' (September 1979, p. 28), I apparently did not make it clear that there are two versions of the subroutine "MACS." The one included in the article performs the sort using the BASIC routine between lines 190 and

(continued on page 200)

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Heathkit, factory assembled & working H11 system (equivalent to LSI/PDP11), with full memory & interfaces plus H10 paper tape reader punch. Total cost over $3400. Best reasonable offer accepted. Mr. Block, (305) 456-6209, or Box 231, Hallandale FL 33009.

For Sale: Two 4K memory boards for Elf II. Fully socketed, with on-board regulator, DIP switch and all data from Netronics. From my working system. $75 each. H. E. Kautz Jr., 1115 E. Caracas Ave., Hershey PA 17033.

For Sale: Digital Group, Inc. Z-80 CPU 34K memory, 16×64 CRT keyboard, KSR-33 printer, 4 Phi-decks. Running on Phimon operating system, including MaxiBasic 2.0, Business Basic, assembler, word processor and a lot more software. Complete documentation, $3500 or best offer. Wayne Peterson, 208 Wis. St. N., Hudson WI 54016. (715) 386-8104.

Anderson-Jacobson 841 hvy dty (Selectric) printer W/EBCD (cmptr) keyboard, RS-232-C serial interface, inst man, ex working cond—$950, fob St. Benedict's Farm, Waelder TX 78959. (512) 540-4814.

OSI C3-OEM, 56K, 2 dbl-sided floppies. OS-65U CP/M, FORTRAN, COBOL w/manuals. Runs OK—getting married. $4000 plus shpng. S. Grayner, 2685 Joann, Oceanside CA 92054. (714) 724-5683 evenings.

For Sale: Heath ET3400 microprocessor trainer (assembled). $160 ($210 w/course books). Neil Omvedt, 8224 Kensington Square, Jacksonville FL 32217. (904) 731-1961.

Wanted: Imsai 8048 control computer, ROM or PROM version. (201) 349-4649. R. Shumaker, 614 Helen Street, Toms River NJ 08753.

For Sale: Complete 6800 Computer Kit with 32K memory. All new professional PC boards, ICs, connectors, Motorola documentation and instruction books. $425. Dave, (412) 264-2135.

For Sale: Digital Group Computer. Has Z-80 CPU, 2K memory, 46 character/line video, cassette I/O, 10 Amp power supply and more. All this is housed in an attractive, heavy-duty cabinet. In good working order. Asking $450 or best offer. Ron Sleeper, 8735 Imperial Hwy #6, Downey CA 90242. (213) 861-3033.

$$$$—WANTED—TRS-80s—WANTED—$$$$ Any quantity, any condition, immediate cash available. Used TRS-80s and peripherals available. Write for firm cash offer. Also used DEC PDP8, 11 CPUs, peripherals. Jim Simpson, Box 632, W. Caldwell NJ 07006. Tel. eves. (201) 226-9185.

Printing Terminal—TI Silent 743 KSR; 10/30 cps with serial interface cable, cover, manual & paper. Perfect condition! $950. J. Lightsey, (303) 443-7888.

Must sell North Star Horizon I—brand new; Horizon II—light use for 1 year; two parallel and serial ports; Soroc IQ 120; Teletype 43; Tektronics 992 scope. Vernan Hogge, 617 Utah, Missoula MT 59801. Phone: (406) 728-7720.

For Sale: Cromemco Z-2 System incl. 21 edge connectors, fan and terminator board. No CPU-Plug in any Z-80. PO Box 1713, Ontario CA 91762. Only $299. Phone (714) 986-8080.

Upgrading all TRS-80 Model I equipment to Model II. Must sell expansion interface with 32K RAM, two Shugart disk drives with cable, four MPI disk drives with cable and one like-new Centronics printer. Expansion interface only $470. Choice of disk drives only $375. Call for price on printer. Bruce Taylor, (918) 825-4844.

TRS-80 users. Update and improve with Heath's H-14 hard copy line printer. 135 characters per second. All new. Heath tested @ $100 off. Price $795. M. D. Jordan, 1111 Taulbee, Austin TX 78757.

For Sale: Digital Group Z-80 26K system, keyboard, monitor, dual Phi-decks, interfaced Selectric II, lots of software. $1700 or best offer. Steven Fornell, (714) 421-4583 after six.

For Sale: 4K × 1 Dynamic RAM (4027). All burned in, all good. $4 each. W. P. Van Horn, 1454 Kelchner Rd., Bethlehem PA 18018.

For Sale: Sylvanhills X-Y Plotter. Used 6 mo. Perfect cond. Interface via 1 TTL parallel port. New $1050. Mike Collins, 609-8th Ave., SE, Minneapolis MN 55414.

For Sale: Imsai 8080 and MIO board 48K RAM, 16K ROM, Lier-ADM3A. North Star: floppy, BASIC, Assembler, Disassemb. System runs superbly. Asking $2800. Rick (313) 453-9022.

For Sale: Digital Group system, 30K RAM, 4K EPROM with custom monitor/debugger, dual Phi-Decks, CDC floppy, Sylvania 12" CRT, custom front panel, paper tape reader, interfaces for audio cassette, Tally printer and PROM blaster, $2200. Optional electronic pinball machine, $400. Bought a larger system. J. Kalafatas, 483 Park St., N. Reading MA 01864. (617) 275-1800 X446 days.

TRS-80 16K, I, $625; 16, II, $749; 16K (selectable I or II), $849; expansion interface, 32K, $549; 2716 EPROM, $40; 2708 EPROM, $8; send check to Desider, 2306 Remo Ct., Santa Clara CA 95054.

Use the Classifieds
if you are a
buyer or a seller!

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320. The second version, which I left out of the article, calls the assembly-language sort routine. I have enclosed another copy of this version of "MACS." I apologize for any problems this may have caused you or your readers."—Richard Blessing.

```
10 DIM P(1000),P1(1000),R$(62)
20 INPUT"NAME OF FILE TO SORT ",A1$
30 INPUT "RECORD FIELD TO SORT ON ",B,E
40 OPEN#0,A1$\READ#0,T1\CLOSE #0
50 E1=INT(T1/256)\E2=T1-(E1*256)\E3=23456\E4=23457\E5=23458\E6=23459
60  FILL E3,E1\FILL E4,E2\FILL E5,E1\FILL E6,E2
70 INPUT"TYPE OF SORT?, ALPHA =A, ALPHA & NUM =AN, NUM =N ",A$
80 A1=4\A2=7\A3=5\A4=6\A6=42\IF A$="AN" THEN 110
90 IF A$="A" THEN 100 ELSE 480
100 A1=5\A2=5.4\A3=6\A4=7\A5=3\A6=61
110 S=(E-B)+1\P=INT(S/A3+.9)\P2=0
120 FOR I=0 TO A1\X(I)=A2↑(2*I)\NEXT
130 IF P>1 THEN N=A3 ELSE N=S-(A3*INT(S/A4))
140 Y=0\OPEN #0,A1$\READ #0,T1
150 READ #0,R$\Y=Y+1\P(Y)=0\P1(Y)=Y\I1=0
160 FOR I=B TO N+B-1\K=(A1-I1)\I1=I1+1
170 R=ASC(R$(I,I))\IF R<48 THEN 180\R=R-A6\GOTO190
180 R=0
190 P(Y)=P(Y)+R*X(K)\NEXT
200 IF Y<T1 THEN 150 ELSE CLOSE #0\B=B+N
210 REM START S / M SORT
220 C=CALL(23491)
230 IF P2<>0 THEN 340 \ P2=1
240 O1=0\N1=0
250 FOR I=1 TO Y
260 N1=P(I)\IF N1<>O1 THEN 280
270 O1=N1\P(I)=P(I-1)\GOTO 290
280 O1=N1\P(I)=I
290 NEXT
300 OPEN #0,"POINT"\FOR I=1TO Y
310 WRITE #0 %(P1(I)-1)*5,P(I),NOENDMARK
320 NEXT\CLOSE #0\P=P-1
330 P3=P3+1\!P3\IF P<=0 THEN 430 ELSE IF A$<>"N" THEN 140 ELSE 480
340 P2=0\N1=0\O1=0
350 FOR I=1 TO Y
360 N1=P(I)\IF N1<>O1 THEN 380
370 O1=N1\P(I)=P(I-1)\GOTO 390
380 O1=N1\P(I)=I
390 NEXT
400 OPEN #0,"POINT"\FOR I=1 TO Y
410 READ #0 %(P1(I)-1)*5,P5\P(I)=P(I)+(1000*P5)
420 NEXT\CLOSE #0\GOTO210
430 INPUT "DO YOU WANT LIST ON TTY?",H$
440 IF H$="YES" THEN Q=1 ELSE Q=0
450 OPEN #0,A1$\READ #0,T\FOR I=1 TO Y\R=P1(I)-1
460 READ #0 %(R*64)+5,R$\!#Q,R,TAB(5),R$\NEXT\CLOSE #0
470 CHAIN "INVENTRY"
480 S=(E-B)+1\P=INT(S/8+.9)\P2=0
490 IF P>1 THEN N=8 ELSE N=S-(8*INT(S/9))\I1=0
500 Y=0\OPEN #0,A1$\READ #0,T1
510 READ #0,R$\Y=Y+1\P(Y)=0\P1(Y)=Y
520 P(Y)=VAL(R$(B,B+N-1))
530 IF Y<T1 THEN 510 ELSE CLOSE #0\B=B+N
540 GOTO 210
```

CALENDAR

New York City

The Center for Management Development of American Management Associations will hold a three-day meeting, entitled "Automating and Integrating Office Systems," October 3-5 at AMA Headquarters, 135 West 50th Street, New York City, and November 26-28 at the Miyako Hotel, San Francisco. Contact Randi Steinberg in New York at (212) 586-8100.

St. Croix

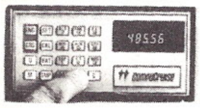
Christmas week 1979 at a quality Caribbean resort. Topics will include systems and application software as well as professional, educational and small-business programs. Volunteers needed now to help organize each area of interest. RSVP immediately for further details on this nonprofit users' holiday-workshop (families welcome): Dr. Andy Bender, 400 Old Hook Rd., Westwood NJ 07675, (201) 664-4882 (days), (201) 652-0157 (nights/weekends); or Dr. Jeff Brownstein, 2 Tor Rd., Wappingers Falls NY 12590, (914) 297-3950.

Please have calendar announcements in our hands at least three months before the month of the issue in which you want the announcement to appear. Keep announcements short and to the point, and send them to the attention of the managing editor to assure their finding their way to the editorial department. Thank you.

COMPUCRUISE

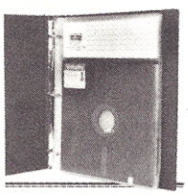
Put a computer in your car, which gives you the most effective and functional cruise control ever designed, plus complete trip computing, fuel management systems, and a remarkable accurate quartz crystal time system.

So simple a child can operate, the new CompuCruise combines latest computer technology with state-of-the-art reliability in a package which will not likely be available on new cars for years to come • Cruise Control • Time, E.T., Lap Timer, Alarm • Time, Distance, Fuel to Arrival • Time, Distance, Fuel to Empty • Time, Distance and Fuel on Trip • Current or Average MPG, GPH • Fuel Used, Distance since Fillup • Current and Average-Vehicle Speed • Inside, Outside or Coolant Temperature • Battery Voltage • English or Metric Display. $199.95



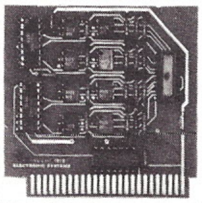
FLOPPY DISK STORAGE BINDER

This black vinyl three-ring binder comes with ten transparent plastic sleeves which accommodate either twenty, five-inch floppy disks. The plastic sleeves may be ordered separately and added as needed. A contents file is included with each sleeve for easy identification and organizing. Binder & 10 holders $14.95 Part No. B800; Extra holders 95¢ each. Part No. 800



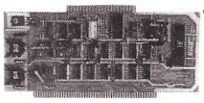
OPTO-ISOLATED PARALLEL INPUT BOARD FOR APPLE II

There are 8 inputs that can be driven from TTL logic or any 5 volt source. The circuit board can be plugged into any of the 8 sockets of your Apple II. It has a 16 pin socket for standard dip ribbon cable connection.
Board only $15.00. Part No. 120, with parts $69.95. Part No. 120A.



TIDMA

• Tape Interface Direct Memory Access • Record and play programs without bootstrap loader (no prom) has FSK encoder/decoder for direct connections to low cost recorder at 1200 baud rate, and direct connections for inputs and outputs to a digital recorder at any baud rate • S-100 bus compatible • Board only $35.00 Part No. 112, with parts $110 Part No. 112A

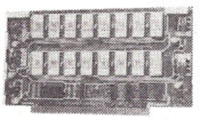


SYSTEM MONITOR

8080, 8085, or Z-80 System monitor for use with the TIDMA board. There is no need for the front panel. Complete with documentation $12.95.

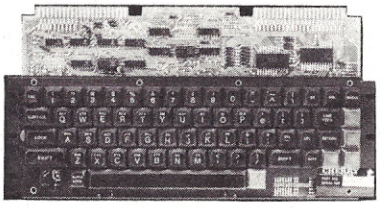
16K EPROM

Uses 2708 EPROMS, memory speed selection provided, addressable anywhere in 65K of memory, can be shadowed in 4K increments. Board only $24.95 part no. 7902, with parts less EPROMs $49.95 part no. 7902A.



ASCII KEYBOARD

TTL & DTL compatible • Full 67 key array • Full 128 character ASCII output • Positive logic with outputs resting low • Data Strobe • Five user-definable spare keys • Standard 22 pin dual card edge connector • Requires +5VDC, 325 mA. Assembled & Tested. Cherry Pro Part No. P70-05AB. $135.00.



ASCII KEYBOARD

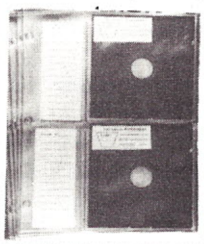
53 Keys popular ASR-33 format • Rugged G-10 P. C. Board • Tri-mode MOS encoding • Two-Key Rollover • MOS/DTL/TTL Compatible • Upper Case lockout • Data and Strobe inversion option • Three User Definable Keys • Low contact bounce • Selectable Parity • Custom Keycaps • George Risk Model 753. Requires +5, -12 volts. $59.95 Kit.

ASCII TO CORRESPONDENCE CODE CONVERTER

This bidirectional board is a direct replacement for the board inside the Trendata 1000 terminal. The on board connector provides RS-232 serial in and out. Sold only as an assembled and tested unit for $229.95. Part No. TA 1000C

DISK JACKET™

Made from heavy duty .0095 matte plastic with reinforced grommets. The mini-diskette version holds two 5-1/4 inch diskettes and will fit any standard three ring binder. The pockets to the left of the diskette can be used for listing the contents of the disk. Please order only in multitudes of ten. $9.95/10 Pack.

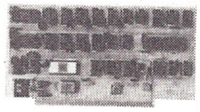


INTERNATIONAL MICROPROCESSOR DICTIONARY

English, French, Danish, German, Italian, Hungarian, Norwegian, Polish, Spanish, Swedish. 10 languages, 28 pp. SYBEX. Ref. IMD. $4.95

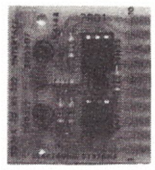
VIDEO TERMINAL

16 lines, 64 columns • Upper and lower case • 5x7 dot matrix • RS-232 in • RS-232 out with TTL parallel keyboard input • On board baud rate generator 75, 110, 150, 300, 600, & 1200 jumper selectable • Memory 1024 characters (7-21L02) • Video processor chip SFF96364 by Neculonic • Control characters (CR, LF, →, ←, ↑, ↓, non destructive cursor, CS, home, CL • White characters on black background or vice-versa • With the addition of a keyboard, video monitor or TV set with TV interface (part no. 107A) and power supply this is a complete stand alone terminal • also S-100 compatible • requires +16, & -16 VDC at 100mA, and 8VDC at 1A. Part no. 1000A $199.95 kit.



RS-232/20mA INTERFACE

This board has two passive, opto-isolated circuits. One converts RS-232 to 20mA, the other converts 20mA to RS-232. All connections go to a 10 pin edge connector. Requires +12 and -12 volts. Board only $9.95, part no. 7901, with parts $14.95 Part No. 7901A.



COMPUCOLOR II

Model 3, 8K $13 95, Model 4, 16K $15 95, Model 5, 32K $18 95. Prices include color monitor, computer, and one disk drive.

PET COMPUTER

With 32K & monitor - $1195. Dual Disk Drive - $1195.

apple II or APPLE II PLUS

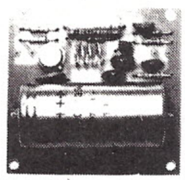
16K - $995, 32K - $1059, 48K - $1123. Disk & cont. $589

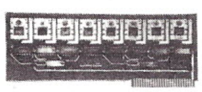
6502 APPLICATIONS BOOK Z80 APPLICATIONS BOOK*

This book will teach you how to connect a board to the outside world and implement practical applications for the 6502, (or Z80). Applications range from home control (a complete alarm system, including heat sensor), to industrial applications. You will learn techniques ranging from simulated traffic control to analog-digital conversion. All experiments can be realized with a minimum of external (low-cost) components. They are directly applicable to any 6502-based board such as SYM, KIM, AIM 65. This book also studies in detail input-output techniques and components, and is the logical continuation of C202 (or C280). By Rodney Zaks. SYBEX. 6502: Ref. D302; Z80: Ref D380. Each $12.95

T.V. INTERFACE

● Converts video to AM modulated RF, Channels 2 or 3. So powerful almost no tuning is required. On board regulated power supply makes this extremely stable. Rated very highly in Doctor Dobbs' Journal. Recommended by Apple ● Power required is 12 volts AC C.T., or +5 volts DC ● Board only $7.60 part No. 107, with parts $13.50 Part No. 107A





PARALLEL TRIAC OUTPUT BOARD FOR APPLE II

This board has 8 triacs capable of switching 110 volt 6 amp loads (660 watts per channel) or a total of 5280 watts. Board only $15.00 Part No. 210, with parts $119.95 Part No. 210A.

To Order: Mention part no. description, and price. In USA shipping paid by us for orders accompanied by check or money order. We accept C.O.D. orders in the U. S. only, or a VISA or Master Charge no., expiration date, signature, phone no., shipping charges will be added. CA residents add 6.5% for tax. Outside USA add 10% for air mail postage and handling. Payment must be in U. S. dollars. Dealer inquiries invited. 24 hour order line (408) 448-0800

Send for FREE Catalog . . . a big self-addressed envelope with 41¢ postage gets it fastest!

ELECTRONIC SYSTEMS

Dept. KB P. O. Box 21638, San Jose, CA USA 95151

Power Supplies! Power Supplies! Power Supplies! SOLID STATE!! (5)

We got 'em! Take your pick...

These units are ideal for micro computers. They have been removed from equipment, checked out and guaranteed.

1---5 volts @ 8 amps + 12 volts + 6 volts @ 75 MA. Power supply has a 3-wire line cord and fused. Dimensions: 10½"x5½"x4½". Shipping weight: 16 lbs. .... 37.50 ea. 2/70.00

2---Model 818, 5 volts at 15 amps + volts at 4 amps--12 volts at 2 amps. (with line cord). .... 35;00 ea. 2/65.00

3---+5 volts at 5 amps ±12 volts at 500 ma. ±6 volts at 25 ma. (line cord included). .... 32.95 ea 2/60.00

4---Elexon, multi output. Input: 120/240 AC, ±10%, 47-63 hz; output: 1) 12V, 1.5A, DC, OVP; 2) 12V, 1.5A, D.C., OVP. New, in box with operating instructions. 31.50

5---Power Design, Model 1210, constant voltage, DC. P.S. input: 105-125. A.C., 55 to 440 hz. Output: 1-12 volts, 0-10 amps, DC. continuously adjustable output voltage and current limiting. 139.00

COMPUTER GRADE CAPACITORS . . .

18,000 mfd 10 VDC	1.25	11,000 mfd 25 VDC	1.50	4,000 mfd 75 VDC	1.75
4,400 mfd 20 VDC	1.00	35,000 mfd 35 VDC	3.50	1,000 mfd 100 VDC	1.00
46,000 mfd 20 VDC	2.50	10,000 mfd 50 VDC	2.50	6,800 mfd 100 VDC	3.50
3,000 mfd 25 VDC	1.00	22,000 mfd 60 VDC	3.75	4,700 mfd 150 VDC	3.75

WIRE WRAP BOARDS

These boards have been removed from equipment. They're prewired, and very easy to unwrap for setting up your own boards. Contains mostly 14-pin IC sockets with individual connections. Each board has VCC and ground planes.

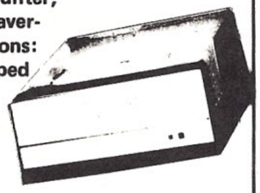
Smaller board measures 6½"x6" and has 40 to 50 sockets. Reduced Price . . . $7.50 ea. 2/$14.00

Larger board measures 13½"x6" and has 75 to 100 sockets. Reduced Price . . . $12.50 ea. 2/$23.00

DIABLO System Disc Drive

SERIES 40, MODEL 43

100 tracks per inch, total capacity of 50 megabits, w/Model 429 power supply, sector counter, 24 sectors, 1 fixed disc, 1 removable disc, average access time 38 ms, PPM:2400, dimensions: 10 5/16" high, fits in standard rack, equipped with full extension slides, excellent used condition. Shipped freight collect.



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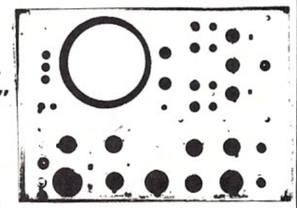
HEWLETT-PACKARD MODEL 175A

OSCILLOSCOPES

These scopes have a 50 Mhz bandwidth and have 2 plug-ins, a 1781B Delay generator and a model 1755A Dual trace vertical amplifier. Dimensions: 13"x17"x25" weight 71 lbs, shipped freight collect. 5" scope. Used. Checked out and operating.



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TRANSFORMERS

ISOLATION STEP-DOWN TYPE

Primary: 230/115V, 50/60 CPS, Secondary: VA output 250V.

$13.95 EACH

ROTRON WHISPER FANS

Unused, Model Rotron MU 3A1, 230V, AC, 14 watts, 50/60 hz, guaranteed, 4½"x4½"x1½"

$8.95

CRYSTAL OSCILLATORS

Vectron type CO-231T crystal freq. 4.9152, mhz w/tuning option for accuracy of .0001%. R.F.E. 1½"x½".

13.95

SG-132 SWEEP SIGNAL GENERATOR

FREQ: 15 TO 400 MHZ, VHF-UHF

Output: AM & FM. CW. FM deviation: ± 1% to ± 20% at any frequency. Crystal markers every 200Khz, 1mhz, 5mhz or ± 10B. Frequency accuracy ±1%. Built-in oscilloscope for observing waveforms.

$329

TRENDLINE PHONES

Manufactured by I.T.T.

These units have rotary dials. Colors are: white, black, red, and green. They are packaged and have 6-foot cord and installation instrructions. Used, but in good operating condition.

34.50

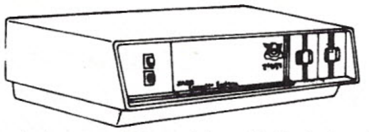
Minimum order $25.00. Items offered subject to prior sale. FOB, Brockton, Mass. Money order or check w/order. Shipments and handling add 5%. Shipments by parcel post or UPS. No CODs. Mass. residents add 5% sales tax.

WALLEN ELECTRONICS CO. INC. INC. Tel: (617) 588-6440-6441
108 SAWTELL AVE., BROCKTON, MA. 02402

ELECTRONIC COMPONENTS
TEST EQUIPMENT
CONNECTORS -- WIRE

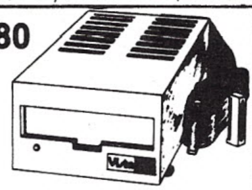
JADE Computer Products

JADE'S NEW MAINFRAME
THE PIGGY IS HERE!



This sleak new mainframe is beautifully designed around JADE'S six slot **ISO-BUS** motherboard and an 18 amp power supply with provisions for up to 3 mini-floppy drives. This is a practical, state-of-the-art design whose looks just can't be beat!
ENS-106320 (without drives) **$475.00**

VISTA V80
TRS-80 MINI-DISK SYSTEM

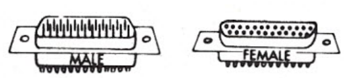


The **V80** out-performs standard Radio Shack drives!--23% more storage capacity, 8 times faster access time, more reliable, and much less expensive. Includes disk drive, power supply, regulator board, and case. **MSM-358000 $395.00**
Interface cable for V80 **WCA-3421** **$24.95**

DISKETTE SPECIAL
5.25" SOFT, 10, OR 16 SECTOR
10 for $29.95
8" SOFT SECTOR IBM COMPATIBLE
10 for $34.95

S-100 CONNECTOR SALE

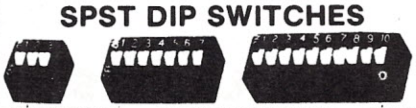
100 PIN IMSAI TYPE SOLDER-TAIL CONNECTOR
6 for $17.50 **12 for $29.95**



RS-232 SET SPECIAL $6.50
DB-25S, DB-25P, DB-25 COVER

DB-25S (FEMALE) **$3.65**
DB-25P (MALE) **$3.15**
DB-25C (COVER) **$1.50**

SPST DIP SWITCHES



PART NUMBER	NUMBER OF SWITCHES	PRICE
SWD-103	**3**	**$1.18**
SWD-104	**4**	**$1.20**
SWD-105	**5**	**$1.24**
SWD-106	**6**	**$1.28**
SWD-107	**7**	**$1.30**
SWD-108	**8**	**$1.34**
SWD-109	**9**	**$1.36**
SWD-110	**10**	**$1.38**

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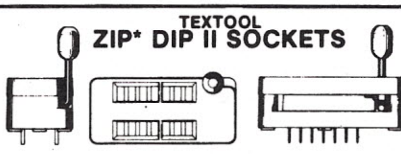
ZIP* DIP II SOCKETS



16 PIN ZIP* DIP II ... $5.50
24 PIN ZIP* DIP II ... $7.50
40 PIN ZIP* DIP II .. $10.25
*** ZERO INSERTION PRESSURE**

JADE'S NEW INTELLIGENT CONTROLLER
THE DOUBLE-D
Read/write in single or **double density.**
8" or 5¼" drives.
CP/M compatible in either single or double density.
On-board Z-80 CPU allows universal compatibility.
Programmed data transfer. **No DMA.**
Controls up to 8 drives.
Software selectable density.
Our new controller utilizes the IBM standard formats for proven reliability. Data recovery is enhanced through the use of a phase-locked-loop data separation circuit and write precompensation. Single and double density disk drives can be mixed in the same system.
KIT **$285.00**
ASSEMBLED & TESTED **$349.00**
BARE BOARD with MANUAL **$55.00**
MANUAL **$10.00**

SD SYSTEMS
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KIT **$159.95**
ASSEMBLED & TESTED **$239.00**

TARBELL
FLOPPY DISK INTERFACE
JADE KIT **$190.00**
ASSEMBLED & TESTED **$260.00**

FLOPPY DISK SPECIAL
TWO SIEMENS 8" DISK DRIVES
JADE DOUBLE-D CONTROLLER KIT
POWER SUPPLY FOR DRIVES
CP/M OPERATING SYSTEM W/BASIC-E
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Shugart SA400 compatible but only two-thirds the size! 40 track, double density 5¼" drive. Very low power consumption!

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Double-sided version of MPI B51.

SHUGART SA400 5¼" DRIVE **$325.00**
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SIEMENS FDD100-8 8" DRIVE **$495.00**
Certfied double density Shugart 801R replacement.Runs much cooler and quieter.

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SHUGART 801R 8" DRIVE **$575.00**
Hard or soft sectored, 400K byte drive.

PERSCI 277 DOUBLE 8" DRIVE **$1595.00**
Limited quantity with slim line case & power supply.

POWER SUPPLIES
For a single 5¼" disk drive.
PSD-249A **$52.00**
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For two 8" disk drives.
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For Rockwell AIM-65.
PSX-030A **$59.95**
For KIM-1 or SYM-1.
PSX-020A **$59.95**

CP/M 2.0
Digital Research has done it again! This new release of their industry standard disk operating system is bound to be an even bigger hit than the original version. All of the fundamental file-size restrictions of release 1 have been eliminated, while maintaining full compatibility with the earlier versions. This new release can be field-configured by the user for a single mini-disk up through a multiple drive hard-disk system with 128 megabyte capacity. Field configuration can be accomplished easily through use of the Macro Library (DISKDEF) provided with CP/M 2.0.
A powerful operating system for only ... $150.00

INTEGRAL DATA SYSTEMS MODEL 440 PRINTER
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Up to 198 CPS
1.75 to 9.5 inch adjustable tractor feed.
Parallel and serial interface.
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For the **Graphics Option** with **2K Buffer** add $199.00

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FAST-150 cps print speed, 80 columns per line.
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Upper and lower case 96 character ASCII set.
5 X 7 dot matrix with software selectable character widths.
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PRM-27081 .... **$749.95**

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THE ANY-PAPER PRINTER
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RS232 or parallel interface.
96 ASCII character set, upper and lower case.
80 characters per line, 7 X 7 dot matrix.
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Weighs less than 10 pounds!
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FREE **12 INCH B & W MONITOR WITH EVERY 16K SORCERER**

Flexibility is the key. The Sorcerer Computer gives you the flexibility of using ready-to-run, pre-packaged programs or doing your won thing and personalizing the programs for yourself. Whic ever you choose. The Sorcerer is the personal computer that speaks your language.
The Sorcerer also provides full graphics capabilities. Each character formed by an 8 x 8 dot cell, can be programmed as a graphic symbol set. High resolution (512 x 240 addressable points) gives a total of 122,880 locations for super animation and extremely light plotting curves. The alphanumeric set gives 64 x 30 characters on the video screen.
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- **12" Black and White**
- **12 MHZ Bandwidth**
- **Handsome Plastic Case**

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MINI-DISK CABLE KIT--Connects two 5¼" mini-floppies to your disk controller board and power supply. Includes 5' signal cable with three 34 pin edge connectors, plus power supply connectors and cables. **WCA-3431K** **$34.95**

SIGNAL CABLE ONLY--Connects one 5¼" drive to edge type controller card. **WCA-3421A** .. **$24.95**
For two 5¼" drives. **WCA-3431A** **$29.95**

8" DISK CABLE KIT--Connects two 8" disk drives to edge type controller card such as the **Versafloppy** and **Double D**. Includes 5' signal cable with three 50 pin edge connectors, plus power supply cables and connectors. **WCA-5031K** **$38.45**
8" DISK CABLE KIT--Same as WCA-5031K except controller end of signal cable has a pin type connector such as the **Tarbell** controller. **WCA-5032K** **$38.95**

J6

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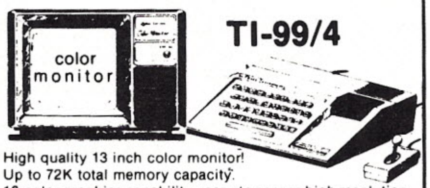
TEXAS INSTRUMENTS

TI-99/4



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Up to 72K total memory capacity.
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SD SYSTEMS

Z-80 STARTER KIT

Based on the powerful Z-80 CPU, this kit is an ideal introduction to microprocessors. It has an on-board keyboard and display, plus cassette tape interface, and expansion provisions for two S-100 connectors. This "Do-it-all-Board" will also program the 2716 2K

Kit	**$249.95**
Assembled and tested	**$439.00**

SD SYSTEMS

SBC-100

An S 100 single board computer. Z 80 CPU with 1024 bytes of RAM 8-32K bytes of PROM Serial I/O port.

Kit	**$239.95**
Assembled	**$369.95**

Solid State Music

I/O 4

2 Serial and 2 Parallel I/O.
Ports S 100 with full hand shaking.

JADE Kit	**$149.95**
Assembled	**$199.95**
Bare Board	**$29.95**

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S-100 compatible, 2 serial I/O ports, 1 parallel I/O.

Kit	**$124.95**
Assembled & Tested	**$179.95**
Bare Board W/ Manual	**$30.00**

PROTO BOARD

Includes gold plated fingers. S-100 size, holds 72-16 pin dips, accomodates all 8 thru 40 pin dip packages. Reg. 19.95
TSXA-140B $16.95

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6502- Based single board computer with keyboard/display, KIM 1 hardware compatible, complete documentation.

SYM-1 CPK-5002A	**$245.00**
SYM-1 CASE, ENX-000005	**$39.95**

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The only motherboard availible today that is designed to IEEE S-100 Bus Standards--a unique network theory of design in which each signal line is surrounded by current mirrored ground lines, significantly reducing RF radiation virtually eliminating crosstalk. No need for active termination. The perfect foundation for a 4MHz system.

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BARE BOARD	**$39.95**
KIT	**$89.95**
ASSEMBLED & TESTED	**$99.95**

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BARE BOARD	**$59.95**
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JADE MEMORY EXPANSION KITS

FOR

TRS-80 APPLE EXIDY

Everything you need to add 16K of memory to your computer. Your kit comes neatly packaged with easy to follow instructions. In just minutes your computer is ready to tackle more advanced software.

$82.00

THE BIG Z

THE NEW Z-80 CPU BOARD FROM JADE

Features include ● S-100 Compatible available in 2MHz or 4MHz versions. ●On-board 2708, 2716, or 2532 EPROM can be addressed on any 1K, 2K or 4K boundary with power-on jump to EPROM. ● On-board EPROM may be used in SHADOW mode, allowing full 64K RAM to be used. ● Automatic MWRITE generation in front panel is not used. ●On-board USART for synchronous or asynchronous R232 operation (on-board baud rate generator). ●Reverse channel capability on USART allows use with buffered peripherals or devices with not-ready signal.

2MHz Kit: CPU-30200K. 2lbs	**$149.95**
Assembled and Tested CPU 30200A 2lbs.	**$199.95**
4MHz Kit: CPU-3020 1K. 2 lbs.	**$159.95**
Assembled and Tested CPU-30201A. 2lbs.	**$209.95**

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8259	$19.95
8275	$69.95
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S2350	$10.95
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2716 (5v)	$49.00
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TMS4027/4096	$4.75
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2111-1	$3.25
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TMS4044 (300ns)	$9.95
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MM5257 (300ns)	$9.95

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A KIM-1 COMPATIBLE MACHINE WITH ON-BOARD PRINTER AND A REAL KEYBOARD!

AIM-65 w/1K of RAM $375.00
AIM-65 w/4K of RAM $450.00
8K BASIC in ROM $100.00
4K Assembler/Editor $80.00
Power Supply $59.95
Case of AIM-65 $49.95

Special Package Price $599.00
4K AIM-65, 8K BASIC ROM, Power Supply, and Case.

SD SYSTEMS

EXPANDORAM

Expandable to 32K or 64K

EXPANDO-32K KITS

Uses 4115 (8K X 1,250ns) Dynamic RAMs. Can be expanded in 8K increments up to 32K

8K	**$159.95**	**24K**	**$249.95**
16K	**$199.95**	**32K**	**$299.95**

EXPANDO-64K KITS

Uses 4116 (16K X 1, 200ns) Dynamic RAMs. Can be expanded up to 64K in 16K increments.

16K	**$249.95**	**48K**	**$469.95**
32K	**$369.95**	**64K**	**$569.95**

STATIC RAM BOARDS

8K 2MHz KIT	**$125.95**
8K 2MHz ASSEMBLED & TESTED	**$175.00**
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8K 4MHz ASSEMBLED & TESTED	**$180.00**
8K BARE BOARD & MANUAL	**$25.00**
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16K BARE BOARD & MANUAL	**$35.00**
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32K 2MHz ASSEMBLED & TESTED	**$650.00**
32K 4MHz KIT	**$619.95**
32K 4MHz ASSEMBLED & TESTED	**$675.00**

SD SYSTEMS

VDB-8024

An **80 by 24** I/O mapped video board for S-100 systems. An on-board Z-80 processor is used to control all functions. A total of 256 user-programmable characters are available, including 128 characters that are supplied with the board. **This is virtually a stand-alone terminal!**

KIT	**$319.95**
ASSEMBLED AND TESTED	**$469.95**

JADE VB-1B

This 64 by 16 memory-mapped video board is ideal for use with word processing software such as the Electric Pencil.

KIT	**$127.50**
ASSEMBLED AND TESTED	**$169.95**
BARE BOARD/MANUAL	**$35.00**

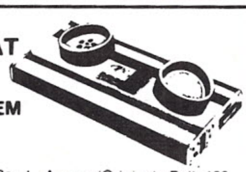
VECTOR GRAPHICS

FLASHWRITER II

The ultimate memory-mapped 80 character by 24 line video board, the Vector Graphics FWII has many advanced features: Onboard parallel keyboard port, Power-on jump circuit, 8 X 10 dot character matrix, and the optional ability to program your own characters and/or graphics symbols. this is THE perfect board for text editing systems.
ASSEMBLED AND TESTED $320.00

NOVATION CAT

ACOUSTIC MODEM



Features include 300 Baud Answer/Originate,Bell 103.
Assembled and Tested $189.00

Sol-20

Sales — Software — Service — Support

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Extended Cassette BASIC	$29.00
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UPDATE PACKAGE: Copies of all the printed update notices that we have that pertain to Processor Technology software and hardware. This includes language updates, manual changes, controller mods, etc. One stack of papers for $15.00.

SERVICE: We do service on Sol-20 computers and Helios II disk drives, both Model 2 and Model 4 versions. We have complete diagnostic hardware and software. Let us know if we can help you.

SALES: We sell Sol-20 computers and peripherals. Call us for availability and prices. Computer Port with warranty these products for 90 days.

FORTRAN UPDATE: We can update your helios FORTRAN disk to make it work. Send us your old FORTRAN disk and $20 and we'll update it to Revision C as modified by Computer Port. If you bought your original FORTRAN from us, the update is free. With the update, you also get all current FORTRAN update documentation.

OPTIONAL PRECISION BASIC: Extended Disk BASIC for the Helios II is available in 12 different versions. 6, 8, 10, 12, 14 and 16 digit precision versions are each available in two versions. One version loads at 100H for systems with 48K of memory. The other version loads 12K of BASIC in high memory with the remainder at 100H (for 64K systems). Send us your BASIC disk and $25 for each version you want.

CUSTOM DRIVERS: If you have a Helios II and a printer, chances are you need a custom driver to output to your printer. Tell us what kind of printer, interface, and programs you are using. Most custom drivers cost $35. Call us.

ESV SOFTWARE

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EC-005	CALENDAR & TIME	10.00
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Details on the above programs may be found in previous issues of Kilobaud. Send for complete catalog of ESV software. Our best sellers are AMAZN, MINE FIELD, DIAGNOSTICS II, and DIS-ASSEM-BLER.

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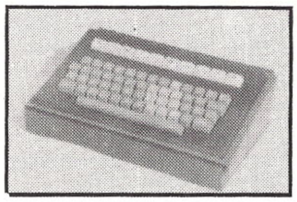
Price: $45.00 ea.
Used with all computers such as: TRS-80, Apple, and many others.



KEYBOARDS

51 key typewriter style keyboard, with case, not encoded. Single contact keys
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5' RG/59U cable with PL259 connector on one end.
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Static Ram 1K x 4 single 5V power supply, single phase TTL level clock, four chip select inputs with data sheets included
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Microprocessor Chips #6502
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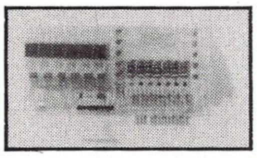

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6 digit numeric display boards with 6 FND 507. Common anode displays and 10 red LED's. With drivers & logic for multiplexed operation.
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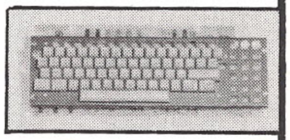
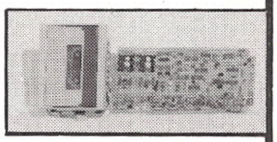


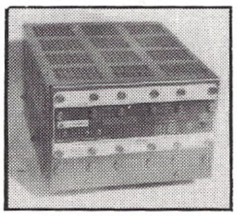
ASCII KEYBOARD

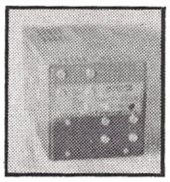
61 key 7 bit plus strobe and parity. Positive logic generates all 128 ASCII characters plus all 32 function codes. Operates on 5 volts. With data
Shpt. Wt. 3#
Price: $25.00 ea



CASSETTE DECK

Standard Phillips type cassette no capstan, reel to reel drive with tachometer control, rewind 300 ft. tape in 60 sec. BOT and EOT sense, also cassette in, door closed and broken tape indication.
Shpt. wt. 5#
Price: $40.00 ea.





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VOLTS	– AMPS	WT.	PRICE
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5	16	18	30.00
5	10	18	25.00
5	4	7	20.00
5	13	20	30.00
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ALL ITEMS ARE REMOVED FROM EQUIPMENT

- Test Equipment
- Power Supply Components
- Power Supplies
- Communication Equipment
- Pulse Equipment

S16

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Penna. resident please add 6% sales tax. All prices are F.O.B. our warehouse, Phila. PA. All merchandise accurate as to description to the best of our knowledge. Your purchase money refunded if not satisfied. Min. order $10.00

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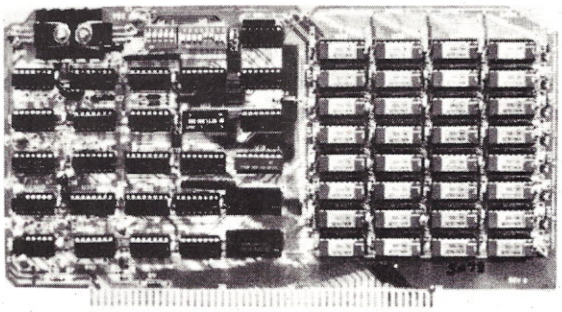
SD EXPANDORAM
The Ultimate S-100 Memory

The EXPANDORAM is available in versions from 16K up to 64K, so for a minimum investment you can have a memory system that will grow with your needs. This is a dynamic memory with the invisable on-board refresh, and IT WORKS!

- Interfaces with Altair, IMSAI, SOL-8, Cromenco, SBC-100, and others.
- Bank Selectable
- Phantom
- Power 8VDC, ±16VDC, 5 Watts
- Lowest Cost Per Bit
- Uses Popular 4116 RAMS
- PC Board is doubled solder masked and has silk-screen parts layout.

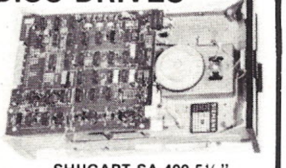


- Extensive documentation clearly written
- Complete Kit includes all Sockets for 64K
- Memory access time: 375ns, Cycle time: 500ns.
- No wait states required.
- 16K boundries and Protection via Dip Switches
- Designed to work with Z-80, 8080, 8085 CPU's.

EXPANDO 64 KIT (4116)

16K	$249
32K	$324
48K	$399
64K	$474

DISC DRIVES



SHUGART SA 400 5¼"
110 KB, 35 tracks.
SHUGART SA 400 **$295.00**

SHUGART SA 400
with attractive metal case with cutouts for Data Cable switch, fuse and power cord.
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SHUGART SA400
with Cabinet and Power Supply. Assembled, tested & guaranteed
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6.4 megabits, single or double density, hard or soft sector, write protect, and more
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Siemens FDD 200-8 8"
double-sided double density
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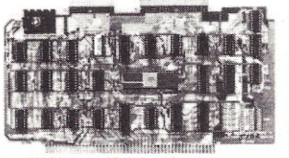
DISC CONTROLLER
SD "VERSAFLOPPY" Kit
The Versatile Floppy Disk Controller
Only $159.00

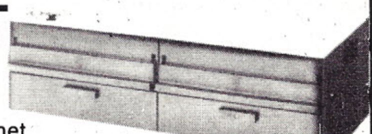


FEATURES: IBM 3740 Soft Sectored Compatible. S-100 BUS Compatible for Z-80 or 8080. Controls up to 4 Drives (single or double sided). Directly controls the following drives:
1. Shugart SA400/450 Mini Floppy
2. Shugart SA800/850 Standard Floppy.
3. PERSCI 70 and 277.
4. MFE 700/750.
5. CDC 9404/9406.
6. GSI/Siemans FDD120-8.

34 Pin Connector for Mini Floppy. 50 Pin Connector for Standard Floppy. Operates with modified CP/M operating system and C-Basic Comptler. The new "Versafloppy" from S.D. Computer Products provides complete control for many of the available Floppy Disk Drives, Both Mini and Full Size. FD1771B-1 Single Density Controller Chip. Listings for Control Software are included in price.

CPM for SD Versafloppy **$100.00**

DUAL SHUGART DISC DRIVES



New from Lobo Drives, a dual Cabinet complete with power supply, and Shugart 801R disc drives.

- Cabinet accepts 2 801R drives mounted side by side horizontally.
- Power Supply for 2 drives
- Ad-on drives available
- Assembled, tested and guaranteed by Lobo Drives.
- Single or double density • Hard or soft sector • Write Protect
- Capacity: Unformatted single density 3.2 megabits
  double density 6.4 megabits
  IBM format, 2 megabits
- 500 KBS transfer, 77 tracks.
- Shugart 800 Series Compatible

LOBO 801R-1 Pcs. Dual Cabinet with 1 drive **$599.00**
LOBO 801R-2 Pcs. Dual Cabinet with 2 drives **$1025.00**
SHUGART 801R Ad-on disc drive **$449.00**

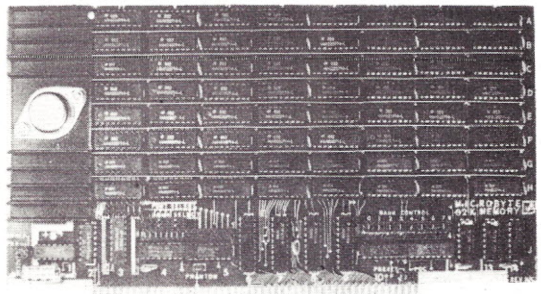
THE MICROBYTE M32KSS 32K STATIC MEMORY BOARD

SAVE $120.00

ASSEMBLED & TESTED
SALE PRICED

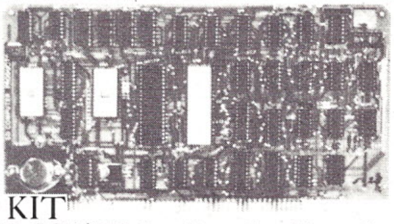
M32 KSS-L (2 MHz)
List $650
SALE $530.00

M32 KSS-H (4 MHz)
List $680
SALE $560.00



• Fully S100 Bus Compatible, IMSAI, SOL, ALTAIR, ALPHA MICRO. • Uses National's Low Power 5257 4K x 1 Static Rams. • 2 MHz or 4 MHz operation. • Gold contacts for higher reliability. • On board single 5 amp regulator. • Thermally designed heat sink (board operating temperature 0° — 70°C). • Commercially designed power bus, 7 ground bus bars, 0.1 uf decoupling capacitors. • Fully tri-state buffered. • Inputs fully low power Shottky Schmitt, Trigger buffered on all address and data lines. • Phantom is jumper selectable to pin 67. • Each 4K bank addressable to any 4K slot with in a 64K boundary. • 4K hardware or software selectable. • One on board 8-bit output port enables or disables the 32K in 4K blocks. • Selectable port address. • 4K banks can be selected or disabled on power on clear or reset. • Will operate with or without front panel. • Compatible with ALPHA MICRO, with extended memory management for selection beyond 64K. • No DMA restriction. • Low power consumption 2.3 — 2.5 amps. • Fully warranted for 120 days from date of shipment.

SD COMPUTER BOARDS



$319 KIT
VDB-8024 Video Display Board
With On-Board Z80 Microprocessor

- Full 80 Characters by 24 lines display
- Characters displayed by High Resolution 7×10 Matrix
- Keyboard Power and Interface
- Composite Video Output
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- On-Board Z80 Microprocessor
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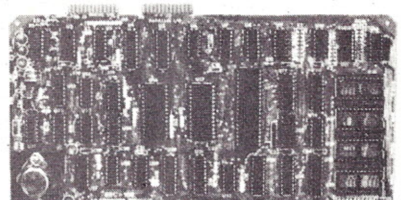
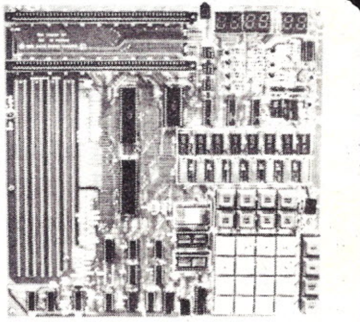
- 96 Upper and Lower Case Characters
- 32 Special Character Set
- 128 Additional user Programmable Characters
- Full Cursor Control
- Forward and Reverse Scrolling Capability
- Operates as an Independent Terminal
- Variable Speed Display Rate
- Blinking, Underlining, Field Reverse, Field Protect and Combinations



$239 KIT
SBC-100 Single Board Computer
with On-board RAM, PROM, CTC

- Four Channel Counter/Timer (Z80-CTC)
- Software Programmable Baud Rate Generator
- S-100 Bus Compatible
- No Front Panel Required for Operation
- Optional Vectored Interrupts
- Z80Central Processing Unit
- 1024 Bytes of Random Access Memory
- 8K Bytes of Available PROM
- Serial Input/Output Port with both Synchronous and Asynchronous Operation
- Parallel Input and Output Ports



$249
Z80 Starter Kit
A Complete Microcomputer on a Board

- Z80 Central Processing Unit with 158 Instructions
- On Board Keyboard and Display
- Kansas City Standard Cassette Interface
- PROM Programmer Built on-board
- Expansion provision for two S-100 Connectors
- Wire Wrap area for custom circuitry
- Single 5 Volt Operation when not programming
- 1K Bytes of RAM (Expandable to 2K Bytes)
- 1K Bytes of RAM (Expandable to 2K Bytes)
- 4 Channel Hardware Counter/Timer (Z80-CTC)
- Two Bi-directional 8-bit I/O Ports (Z80-PIO)
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- 2K Byte ZBUG Monitor in ROM
- Memory Examine and Change
- Port Examine and Change
- Z80 CPU Register Examine and Change
- Up to 5 Programmable Breakpoints
- Single Step through RAM or PROM
- Audio Cassette Load and Dump
- Vectored Interrupts provided by Z80-CTC and Z80-PIO
- Ideal for Experimentaion and Evaluating the Z80 CPU

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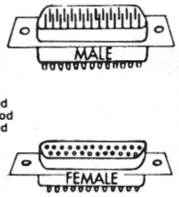
FREE BATTERY with your meter.

RS232 & "D" TYPE CONNECTORS

P = Plug-Male S = Socket-Female C = Cover-Hood



PART NO.	DESCRIPTION	PRICE 1-4	5-9	10-24
DE-9P	9 Pin Male	1.50	1.30	1.20
DE-9S	9 Pin Female	2.15	2.05	1.95
DE-9C	9 Pin Cover	1.50	1.30	1.15
DA15P	15 Pin Male	2.20	2.00	1.80
DA15S	15 Pin Female	3.20	3.00	2.80
DA15C	15 Pin Cover	1.60	1.45	1.30
DB-25P	25 Pin Male	2.90	2.60	2.50
DB-25S	25 Pin Female	3.75	3.65	3.40
DB51212-1	1 pc. Grey Hood	1.65	1.40	1.20
DB1226-1A	2 pc. Black Hood	1.90	1.60	1.50
DB110963-3	2 pc. Grey Hood	1.80	1.55	1.35
DC37P	37 Pin Male	3.95	3.80	3.60
DC37S	37 Pin Female	5.75	5.50	5.20
DC37C	37 Pin Cover	2.20	1.95	1.75
DD50P	50 Pin Male	4.95	4.75	4.50
DD50S	50 Pin Female	7.50	7.20	6.90
DD50C	50 Pin Cover	2.50	2.20	2.10
D20418-S	Hardware Set (2 pair)	1.00	.80	.70

Connector for CENTRONICS 700 SERIES:
Amphenol 57-30360 for back of Centronics 700 Series printers
1-4—$9.00 5-up—$7.50

SALE S-100 BUS EDGE CONNECTORS SALE

S100-WWG 50/100 Cont. .125 ctrs. 3 LEVEL WIRE WRAP .025" sq. posts on .250 spaced rows. GOLD PLATED.

1-4	5-9	10-24
$4.00	$3.75	$3.50

S100-STG 50/100 Cont. .125 ctrs. DIP SOLDER TAIL on .250 spaced rows for VECTOR, IMSAI, CROMENCO motherboards GOLD plated.

1-4	5-9	10-24
$3.50	$3.25	$3.00

S100ALT 50/100 Cont. .125 ctrs. DIP SOLDER TAIL on .140 spaced rows for ALTAIR motherboards. GOLD plated.

1-4	5-9	10-24
$4.50	$4.25	$4.00

S100SE 50/100 Cont. .125 ctrs. PIERCED SOLDER EYELET tails. GOLD

1-4	5-9	10-24
$5.00	$4.50	$4.00

Other Popular Edge Connectors

D2244-5SE 22/44Cont. .156 ctrs.PIERCED SOLDER EYELET tails. GOLD plated.

1-4	5-9	10-24
$3.00	$2.60	$2.20

D2244-5WW 22/44 Cont. .156 ctrs. WIRE WRAP tails. GOLD.

1-4	5-9	10-24
$3.95	$3.70	$3.40

CG-1 IMSAI Style Card Guides 5/$1.00

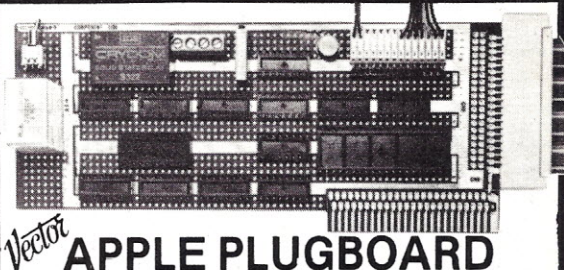
See our July Ad for many other connectors.

3 LEVEL GOLD WIRE WRAP SOCKETS

Sockets purchased in multiples of 50 per type may be combined for best price.

	1-9	10-24	25-99	100-249	250-999
8 pin	.40	.36	.34	.31	.27
14 pin	.39	.38	.36	.34	.32
16 pin	.50	.42	.40	.36	.34
18 pin	.70	.60	.55	.50	.45
20 pin	.90	.80	.75	.65	.62
22 pin	.95	.85	.80	.70	.65
24 pin	.95	.85	.80	.70	.65
28 pin	1.25	1.15	1.00	.95	.90
40 pin	1.65	1.45	1.35	1.20	1.10

All sockets are GOLD 3 level closed entry. 2 level Tail, Low Profile, Tin Sockets and Dip Plugs available. CALL FOR QUOTATION.



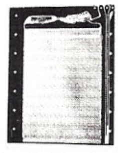
Vector APPLE PLUGBOARD

Vector 4609 Peripheral Interface Plugboard for construction of custom circuits. Plug compatible with Apple II, Commodore PET and Super Kim microcomputers. Three connectors, in addition to the standard 25/50 system bus, are available for input/output. A 20/40-contact card-edge connector, fabricated on the rear of the board, mates with a 3-M type ribbon connector. Alternatively, a right-angle solder-tail header may be positioned in this same location. The Model 4609 also accomodates the miniature SIP-type connectors which may be placed on the periphery or in mid-board.

1-4	5-9	10-24
$21.50	$19.36	$17.26

8803 MOTHER BOARD FOR S100 BUS MICRO-COMPUTERS — Vector

- Kit includes 12 tantalum capacitors for +5, +12, −12 buses and insulated mounting spacers
- Wiring side shown. Component side bare epoxy glass with white markings for component locations
- G10 epoxy glass board with 2 ounce copper, solder plated and .038 diameter holes for leads
- Solder mask with solder windows on etched circuits to avoid accidental short circuits
- Mounts 11 receptacles with 100 contacts (2 rows) on .125 centers with .250 row spacing. Vector part number R681-2, or mounts 10 receptacles plus interconnections to smaller mother board for expansion
- Includes etched circuits and instructions for option of active, pull-up, or floating terminations
- Large buses +5V and GND (10 AMPS), ± 12V or 16V (7 AMPS). Current ratings are per MIL-STD-275 with 10°C rise
- Fits in Vector-pak enclosures
- Fits in IMSAI 8080 microcomputer as expander board



Price: $29.50

Vector Plugboards

8800V

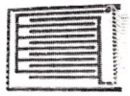
Universal Microcomputer/processor plugboard, use with S-100 bus. Complete with heat sink & hardware 5.3" x 10" x 1/16"

1-4	5-9	10-24
$19.95	$17.95	$15.96

8801-1

Same as 8800V except plain; less power buses & heat sink.

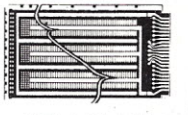
1-4	5-9	10-24
$15.22	$13.79	$12.18



3682 9.6" x 4.5" **$12.97**

3682-2 6.5" x 4.5" **$9.81**

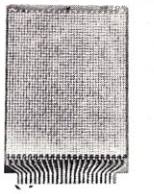
Hi-Density Dual-In-Line Plugboard for Wire Wrap with Power & Grd. Bus Epoxy Glass 1/16" 44 pin con. spaced .156



3677 9.6" x 4.5" **$10.90**

3677-2 6.5" x 4.5" **$9.74**

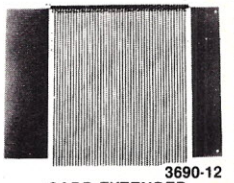
Gen. Purpose D.I.P. Boards with Bus Pattern for Solder or Wire Wrap. Epoxy Glass 1/16" 44 pin c n. spaced .156



3662 6.5" x 4.5" **$8.95**

3662-2 9.6" x 4.5" **$11.45**

P pattern plugboards for IC's Epoxy Glass 1/16" 44 pin con. spaced .156



3690-12

CARD EXTENDER

Card Extender has 100 contacts 50 per side on .125 centers-Attached connector-is compatible with S-100 Bus Systems. **$25.83**

3690 6.5" 22/44 pin .156 ctrs. Extenders $13.17

1/16 Vector BOARD

.042 dia holes on 0.1 spacing for IC's

Phenolic PART NO.	SIZE	PRICE 1-9	10-19
64P44XXXP	4.5x6.5"	$1.56	$1.40
169P44XXXP	4.5x17"	$3.69	$3.32
Epoxy Glass			
64P44	4.5x6.5"	$1.79	$1.61
84P44	4.5x8.5"	$2.21	$1.99
169P44	4.5x17"	$4.52	$4.07
169P84	8.5x17"	$8.83	$7.94

TRS-80/APPLE MEMORY EXPANSION KITS

4116's RAMS

from Leading Manufacturers

(16Kx1 200/250ns)

8 for $75.00

Add $3.00 for programming Jumpers for TRS-80 Keyboard

IC SOCKET SALE

- 14 pin Low Profile 10/$2.10 **100/$14.00**
- 16 pin Low Profile 10/$2.20 **100/$16.00**
- 24 pin Low Profile 3/$1.00 **40/$10.00**
- 40 pin Solder Tail 3/$1.00 **40/$10.00**
- 24 pin Dip Plug with cover 3/$1.00 **40/$10.00**

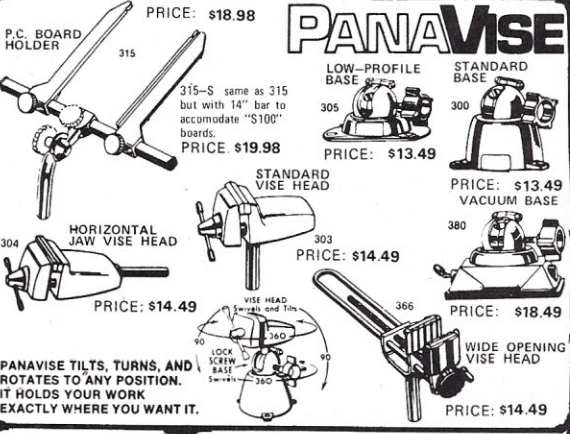
WOW 14 & 16 PIN GOLD 3 LEVEL WIRE WRAP SOCKES

14 - G3 100 for **$33.00**

16 - G3 100 for **$33.00**

50 of each for **$35.00**

PANAVISE



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MEMORY MEMORY

2102LIPC Low Power 450ns in lots of 25	$1.10
2102AL-2 Low Power 250ns in lots of 25	$1.25
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2716 16K 5 Volt Only EPROM	$45.00

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IM-10A List $89.00 SPECIAL $56.95 with tube

Perfectly balanced fluorescent lighting with precision magnifier lens. Tough thermoplastic shade. Easy lens removal. New wire clip design permits easy installation and removal of fluorescent tube. Comes with plastic shield to protect tube from soiling and damage.

Colors: Gray, Black, and Chocolate Brown. Comes with one 22 watt T-9 Circline fluorescent tube. 3 diopter lens.

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Vector WRAP POST

for .042 dia. holes (all boards on this page)

- **T44/C** pkg. 100 .. **$ 2.34**
- **T44/M** pkg. 1000 ..... **$14.35**
- **A-13** hand installing tool .... **$ 4.19**

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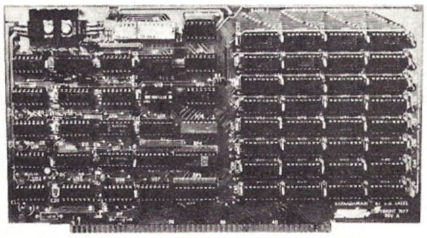
SD EXPANDORAM

The EXPANDORAM is available in versions from 16K up to 64K, so for a minimum investment you can have a memory system that will grow with your needs. This is a dynamic memory with the invisable on-board refresh, and IT WORKS!

- Bank Selectable
- Phantom
- Power 8VDC, +16VDC, 5 Watts
- Lowest Cost Per Bit
- Uses Major Brand 16K RAMS
- PC Board is doubled solder masked and has silk-screen parts layout
- Extensive documentation clearly written



- Complete kit includes all Sockets for 64K
- Memory access time: 375ns, Cycle time: 500ns.
- No wait states required
- 16K boundries and Protection via Dip Switches
- Designed to work with Z-80, 8080, 8085 CPU's

EXPANDORAM 64K Kit (16K Ram)

16K	$219.00
32K	$279.00
48K	$359.00
64K	$419.00
WITHOUT MEMORY	$159.00

We carry a full line of SD Systems Products. Please write for catalog or call for prices

PROM - 100 PROM Programmer Board

The PROM-100 Programmer is a development tool for S-100 Bus computer systems. The Zero Insertion Force Programming Socket extends above the card cage height for easy access to PROM devices. Software verifies PROM erasure, verifies program loading and provides for reading of object file from Disk or PROM and programming into PROM/EPROM. Features include: On-board generated 25vdc Programming pulse, TTL compatible, maximum programming time for 16,389 bits is 100 seconds. Programs: 2708, Intel 2758, 2716, 2732 and TI 2516. DIP Selectable EPROM type.

PROM-100 Board Kit $ 149.95

NEW ! First Time Offered MPB-100 Z80 CPU Board Kit

The MPB-100 provides a Z80 microprocessor based CPU for S-100 Bus systems. Front panel usage is optional making the MPB-100 suitable for upgrading existing systems to Z80 level. A PROM socket is provided on-board which makes the MPB-100 adaptable to process control applications. Features include: Power-on Jump to 4K boundaries, 2 Megahertz or 4 Megahertz operation, optional wait states, on-board PROM socket.

MPB-100 Kit $ 199.00

"VERSAFLOPPY" KIT

The Versatile Floppy Disk Controller
Only $139.00

FEATURES: IBM 3740 Soft Sectored Compatible. S-100 BNS Compatible for Z-80 or 8080. Controls up to 4 Drives (single or double sided). Directly controls the following drives:

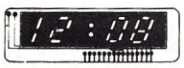
1. Shugart SA400/450 Mini Floppy
2. Shugart SA800/850 Standard Floppy
3. PERSCI 70 and 277
4. MFE 700/750
5. CDC 9404/9406

BOWMAR 4 DIGIT READOUT ARRAY

4 Jumbo .50" Digits In One "Stick"!

The Bowmar Opto-Stick. The best readout bargain we have ever offered. Has four common cathode jumbo digits with all segments and cathodes brought out. Increased versatility since any of the digits may be used independently to fit your applications. Perfect for any clock chip, especially direct drive units like 50380 or 7010. Also use in freq. counters, DVM's etc. For 12 or 24 hour format. (With colons and AM/PM indicator.)

$ 1.99



VDB-8024 Video Dispaly Board

The VDB-8024 features its own on-board Z80 microprocessor. This gives the capability of using software (included in ROM) to control functions and enhancements without interference with the computer's CPU. Included in the special features: 80 characters by 24 lines display, Keyboard power and interface, Composite and separate video output, 2K on-board RAM, a total of 256 available characters, full cursor control, Forward and Reverse Scrolling, Underlining, Field Reverse, Field Protect enhancements, programmable characters.

VDB-8024 KIT $ 319.00

TELE TAPE

Record important telephone con-versations now with Tele Tape and your recorder. Each time your receiver is picked up your recorder will automatically start! When you hang-up the recorder stops. Tape will be extra clear so you can refresh your memory at a later date. Kit includes everything except the case and phono plugs.

Assembled & Tested Only
$ 29.95

MINIATURE SPEAKER SPECIAL!

2 INCH — .8 OHM.
PERFECT FOR CLOCKS! **$.79**

*TO -5 HEATSINKS**

Similar to Thermalloy 2205G
Finned with insert.
5 for $1

ROCKER SWITCH*

HEAVY DUTY
S.P.D.T. 3A. 125 V.A.C.
New, modern styling! ***5 for $1***

Z80 STARTER KIT

SD System's Z80 Starter Kit enables the novice to build a complete microcomputer on a single board. Featuring the powerful Z80 microprocessor the Z80 Starter Kit features: • Keyboard and Display • Audio Interface • PROM Programmer • Expansion and Wire Wrap Area • On Board RAM • 4 Channel Counter/Timer • Z-BUG Monitor in PROM • I/O Ports.

This month's Special:
$219.95 Kit $369.95 A&T

SBC-100 SINGLE BOARD COMPUTER

The SBC-100 provides a complete micro-computer on a single board! The Z80 microprocessor is used as the heart of the SBC-100. The SBC-100 meets all the requirements of a Z80 CPU board with the added features of I/O ports, counter/timer channels, on board RAM, provisions for PROM/ROM and a software programmable baud rate generator. S-100 Bus compatible, the SBC-100 features are: 8K bytes of available PROM, 1024 bytes on-board RAM, Serial I/O with both synchronous and asynchronous operation, Parallel I/O ports, Optional Vectored Interrupts, and Four Counter/Timer Channels. SD Monitor available for RS-232 and Video Terminals. Disk based system software also available.

SBC-100 KIT $ 219.00

COMPUTER CORNER

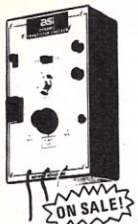
CPU's	
Z80	10.99
Z80A	13.99
RELATED CHIPS	
2114 (300ns)	5.99
Z80 PIO	9.95
Z80CTC	11.95
2708	8.99
4115	8 for 34.95
4116	8 for 80.00
DISC CONTROLLER	
1771	29.95

TERMS: Add 30¢ postage, we pay balance. Orders under $15 add 75¢ handling. No C.O.D. We accept Visa, MasterCharge, and American Express cards. Tex. Res. add 5% Tax. Foreign orders (except Canada) add 20% P&H. 90 Day Money Back Guarantee on all items

Color Burst Crystal (3.57MHz) **89¢**

While in Dallas visit our retail store at Treehouse Shopping center. Garland Road and Jupiter.

Transistor Checker



— Completely Assembled —
— Battery Operated —

The ASI Transistor Checker is capable of checking a wide range of transistor types, either "in circuit" or out of circuit. To operate, simply plug the transistor to be checked into the front panel socket, or connect it with the alligator clip test leads provided. The unit safely and automatically identifies low, medium and high-power PNP and NPN transistors. Size: 3¾" x 6¾" x 2"
"C" cell battery not included.

ON SALE!

Trans-Check $19.95 ea.

Custom Cables & Jumpers

NEW NEW

DB 25 Series Cables

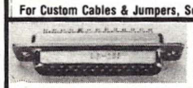
Part No.	Cable Length	Connectors	Price
DB25P-4-P	4 Ft.	2-DP25P	$15.95 ea.
DB25P-4-S	4 Ft.	1-DP25P/1-25S	$16.95 ea.
DB25S-4-S	4 ft.	2-DP25S	$17.95 ea.

Dip Jumpers

DJ14-1	1 ft.	1-14 Pin	$1.59 ea.
DJ16-1	1 ft.	1-16 Pin	1.79 ea.
DJ24-1	1 ft.	1-24 Pin	2.79 ea.
DJ14-1-14	1 ft.	2-14 Pin	2.79 ea.
DJ16-1-16	1 ft.	2-16 Pin	3.19 ea.
DJ24-1-24	1 ft.	2-24 Pin	4.95 ea.

For Custom Cables & Jumpers, See JAMECO 1979 Catalog for Pricing

CONNECTORS



25 Pin-D Subminiature

DB25P (as pictured)	PLUG (Meets RS232)	$2.95
DB25S	SOCKET (Meets RS232)	$3.50
DB51226-1	Cable Cover for DB25P or DB25S	$1.75

PRINTED CIRCUIT EDGE-CARD

.156 Spacing-Tin-Double Read-Out — Bifurcated Contacts — Fits .054 to .070 P.C. Cards

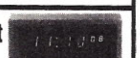
15/30 SE	PINS (Solder Eyelet)	$1.95
18/36 SE	PINS (Solder Eyelet)	$2.49
22/44 SE	PINS (Solder Eyelet)	$2.95
22/44 WW	PINS (Wire Wrap)	$3.95
50/100 WW (.125 Spacing)	PINS (Wire Wrap) R681-1	$6.95

4-Digit Clock Kit

* Bright .357" ht. red display
* Sequential flashing colon
* 12 or 24 hour operation
* Extruded aluminum case (black)
* Pressure switches for hours, minutes & hold functions
* Includes all components, case and wall transformer
* Size: 3¼ x 1¾ x 1¼

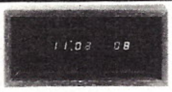
JE730 .... $14.95

Jumbo 6-Digit Clock Kit



* Four .630"ht. and two .300"ht. common anode displays
* Uses MM5314 clock chip
* Switches for hours, minutes and hold functions
* Hours easily viewable to 30 feet
* Simulated walnut case
* 115VAC operation
* 12 or 24 hour operation
* Includes all components, case and wall transformer
* Size: 6¾ x 3⅛ x 1¾

JE747 .... $29.95



* Bright .300 ht. comm. cathode display
* Uses MM5314 clock chip
* Switches for hours, minutes and hold modes
* Hrs. easily viewable to 20 ft.
* Simulated walnut case
* 115 VAC operation
* 12 or 24 hr. operation
* Incl. all components, case & wall transformer
* Size: 6¾" x 3-1/8" x 1¾"

JE701

6-Digit Clock Kit $19.95

REMOTE CONTROL TRANSMITTER & RECEIVER

* CAN BE USED AS REMOTE CONTROL FOR TV
* USE IT FOR YOUR OWN GARAGE DOOR OPENER
* TRANSMITS BETWEEN 38KHz AND 41.5KHz
* THOUSANDS OF USES FOR REMOTE CONTROL APPLICATIONS
* TRANSMITTER USES A 1.5V BATTERY
* SCHEMATIC INCLUDED

$19.95

Digital Stopwatch Kit

* Use Intersil 7205 Chip
* Plated thru double-sided P.C. Board
* LED display (red)
* Times to 59 min. 59.59 sec. with auto reset
* Quartz crystal controlled
* Three stopwatches in one: single event, split (cummulative) & taylor (sequential timing)
* Uses 3 penlite batteries
* Size: 4.5" x 2.15" x .90"

JE900 $39.95

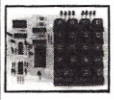
MICROPROCESSOR COMPONENTS

Part	Description	Price
8080A/8080A SUPPORT DEVICES		
8080A	CPU	$ 7.95
8212	8-Bit Input/Output	3.25
8214	Priority Interrupt Control	5.95
8216	Bi-Directional Bus Driver	3.49
8224	Clock Generator/Driver	3.95
8226	Bus Driver	3.49
8228	System Controller/Bus Driver	4.95
8238	System Controller	5.95
8251	Prog. Comm. 1/0 (USART)	7.95
8253	Prog. Interval Timer	14.95
8255	Prog. Periph. 1/0 (PPI)	9.95
8257	Prog. DMA Control	19.95
8259	Prog. Interrupt Control	19.95
6800/6800 SUPPORT DEVICES		
MC6800	MPU	$14.95
MC6802CP	MPU with Clock and Ram	24.95
MC6810API	128X8 Static Ram	5.95
MC6821	Periph. Inter. Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	12.95
MC6830L8	1024X8 Bit ROM (MC68A30-8)	14.95
MC6850	Asynchronous Comm. Adapter	7.95
MC6852	Synchronous Serial Data Adapt.	9.95
MC6860	0-600 bps Digital MODEM	12.95
MC6862	2400 bps Modulator	14.95
MC6880A	Quad 3-State Bus. Trans. (MC8T26)	2.25
MICROPROCESSOR CHIPS—MISCELLANEOUS		
Z80(780C)	CPU	$14.95
Z80A(780-1)	CPU	16.95
CDP1802	CPU	19.95
2650	MPU	19.95
6502	CPU	11.95
8035	8-Bit MPU w/clock, RAM, 1/0 lines	19.95
P8085	CPU	19.95
TMS9900JL	16-Bit MPU w/hardware, multiply & divide	49.95
SHIFT REGISTERS		
MM500H	Dual 25 Bit Dynamic	$.50
MM503H	Dual 50 Bit Dynamic	.50
MM504H	Dual 16 Bit Static	.50
MM506H	Dual 100 Bit Static	.50
MM510H	Dual 64 Bit Accumulator	.50
MM5016H	500/512 Bit Dynamic	.89
2504T	1024 Dynamic	3.95
2518	Hex 32 Bit Static	4.95
2522	Dual 132 Bit Static	2.95
2524	512 Static	.99
2525	1024 Dynamic	2.95
2527	Dual 256 Bit Static	2.95
2528	Dual 250 Static	4.00
2529	Dual 240 Bit Static	4.00
2532	Quad 80 Bit Static	2.95
3341	Fifo	6.95
74LS670	4X4 Register File (TriState)	2.49
UART'S		
A-Y-5-1013	30K BAUD	5.95

Part	Description	Price
MICROPROCESSOR MANUALS		
M-Z80	User Manual	$7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00
ROM'S		
2513(2140)	Character Generator(upper case)	$9.95
2513(3021)	Character Generator(lower case)	9.95
2516	Character Generator	10.95
MM5230N	2048-Bit Read Only Memory	1.95

Part	Organization	Type	Price
RAM'S			
1101	256X1	Static	$1.49
1103	1024X1	Dynamic	.99
2101(8101)	256X4	Static	3.95
2102	1024X1	Static	1.75
21L02	1024X1	Static	1.95
2111(8111)	256X4	Static	3.95
2112	256X4	Static MOS	4.95
2114	1024X4	Static 450ns	7.95
2114L	1024X4	Static 450ns low power	10.95
2114-3	1024X4	Static 300ns	10.95
2114L-3	1024X4	Static 300ns low power	11.95
5101	256X4	Static	7.95
5280/2107	4096X1	Dynamic	4.95
7489	16X4	Static	1.75
74S200	256X1	Static Tristate	4.95
93421	256X1	Static	2.95
UPD414 (MK4027)	4K	Dynamic 16 pin	4.95
UPD416 (MK4116)	16K	Dynamic 16 pin 250ns	9.95
TMS4044-45NL	4K	Static	14.95
TMS4045	1024X4	Static	14.95
2117	16,384X1	Dynamic 350ns (house marked)	9.95
MM5262	2KX1	Dynamic	4/1.00
PROM'S			
1702A	2048	FAMOS	$5.95
2716INTEL	16K*	EPROM	59.95
TMS2516	16K*	EPROM	49.95
(2716)	*Requires single +5V power supply		
TMS2532	4KX8	EPROM	89.95
2708	8K	EPROM	10.95
2716 T.I	16K**	EPROM	29.95
	**Requires 3 voltages, —5V, +5V, +12V		
5203	2048	FAMOS	14.95
6301-1(7611)	1024	Tristate Bipolar	3.49
6330-1(7602)	256	Open C Bipolar	2.95
82S23	32X8	Open Collector	3.95
82S115	4096	Bipolar	19.95
82S123	32X8	Tristate	3.95
74186	512	TTL Open Collector	9.95
74188	256	TTL Open Collector	3.95
74S287	1024	Static	2.95

JE600 HEXADECIMAL ENCODER KIT



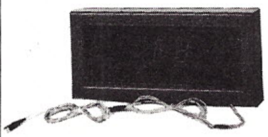
FEATURES:
* Full 8 bit latched output for microprocessor use
* 3 User Define keys with one being bistable operation
* Debounce circuit provided for all 19 keys
* LED readout to verify entries
* Easy interfacing with standard 16 pin IC connector
* Only +5VDC required for operations

FULL 8 BIT LATCHED OUTPUT—19 KEYBOARD

The JE600 Encoder Keyboard provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8 bit microprocessor or 8 bit memory circuits. Three (3) additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with LED readouts. Also included is a key entry strobe.

JE600 .... $59.95
Hexadecimal Keypad only $14.95

DIGITAL THERMOMETER KIT



* Dual sensors—switching control for indoor/outdoor or dual monitoring
* Continuous LED .8" ht. display
* Range: -40°F to 199°F / -40°C to 100°C
* Accuracy: ±1° nominal
* Set for Fahrenheit or Celsius reading
* Sim. walnut case - AC wall adapter incl.
* Size: 3-1/4"Hx6-5/8"Wx1-3/8"D

JE300 .... $39.95

62-Key ASCII Encoder Keyboard Kit

The JE610 62-Key ASCII Encoder Keyboard Kit can be interfaced into most any computer system. The JE610 Kit comes complete with an industrial grade keyboard switch assembly (62 keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and −12V @ 10mA for operation.

FEATURES:
* 60 Keys generate the full 128 characters, upper and lower case ASCII set
* Fully buffered
* 2 user-define keys provided for custom applications
* Caps lock for upper case only alpha characters
* Utilizes a 2376 (40 pin) encoder read only memory chip
* Outputs directly compatible with TTL/DTL or MOS logic arrays
* Easy interfacing with a 16-pin dip or 18-pin edge connector

JE610 ..... $79.95
62-Key Keyboard only . . $34.95

REGULATED POWER SUPPLY

NEW

JE200

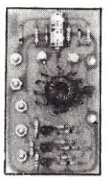
5V-1 AMP POWER SUPPLY

* Uses LM309K
* Heat sink provided
* PC Board construction
* Provides a solid 1 amp @ 5 volts
* Can supply up to ±5V, ±9V and ±12V with JE205 Adapter
* Includes components, hardware & instructions
* Size: 3½"x5"x2"H

JE200 $14.95

JE205

ADAPTER BOARD — Adapts to JE200 — ±5V, ±9V and ±12V



* DC/DC converter w/ +5V input
* Toriodal hi-speed switching XMFR
* Short circ. protection
* PC Brd. construction
* Piggy-back to JE200 board
* Size: 3½"x2"x9/16"h

JE205 $12.95

$10.00 Min. Order — U.S. Funds Only
Calif. Residents Add 6% Sales Tax
Postage—Add 5% plus $1 Insurance (if desired)

Spec Sheets — 25¢
1980 Catalog Available — Send 41¢ stamp

FREE 1980 CATALOG

Jameco ELECTRONICS J1

PHONE ORDERS WELCOME (415) 592-8097

MAIL ORDER ELECTRONICS – WORLDWIDE
1021 HOWARD AVENUE, SAN CARLOS, CA 94070
ADVERTISED PRICES GOOD THRU NOVEMBER

The Incredible "Pennywhistle 103"

$139.95 Kit Only

The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modern and terminal for telephone "hamming" and communications. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

Data Transmission Method .....Frequency-Shift Keying, full-duplex (half-duplex selectable).
Maximum Data Rate...........300 Baud.
Data Format ....Asynchronous Serial (return to mark level required between each character).
Receive Channel Frequencies ...2025 Hz for space; 2225 Hz for mark.
Transmit Channel Frequencies ..Switch selectable: Low (normal) = 1070 space, 1270 mark; High = 025 space, 2225 mark.
Receive Sensitivity ....−46 dbm accoustically coupled.
Transmit Level ....−15 dbm nominal. Adjustable from −6 dbm to −20 dbm.
Receive Frequency Tolerance ...Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz.
Digital Data Interface ....EIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar).
Power Requirements ....120 VAC, single phase, 10 Watts.
Physical.......................All components mount on a single 5" by 9" printed circuit board. All components included.
Requires a VOM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align.

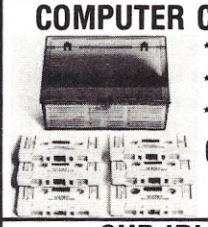
TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K. Kit comes complete with:

* 8 each UPD416-1 (16K Dynamic Rams) 250NS
* Documentation for conversion

TRS-16K $75.00

COMPUTER CASSETTES

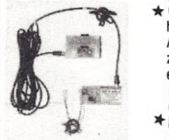


* 6 EACH 15 MINUTE HIGH QUALITY C-15 CASSETTES
* PLASTIC CASE INCLUDED 12 CASSETTE CAPACITY
* ADDITIONAL CASSETTES AVAILABLE #C-15-$2.95 ea

CAS-6 $14.95
(Case and 6 Cassettes)

SUP 'R' MOD II

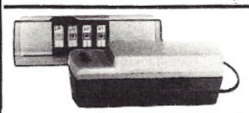
UHF Channel 33 TV Interface Unit Kit



Wide Band B/W or Color System
* Converts TV to Video Display for home computers, CCTV camera, Apple II, works with Cromeco Dazzler, SOL-20, IRS-80, Challenger, etc.

MOD II is pretuned to Channel 33 (UHF).
* Includes coaxial cable and antenna transformer.

MOD II $29.95 Kit



ULTRA-VIOLET PRODUCTS, INC.

EPROM Erasing Lamp

* Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
* Erases up to 4 chips within 20 minutes.
* Maintains constant exposure distance of one inch
* Special conductive foam liner eliminates static build-up
* Built-in safety lock to prevent UV exposure
* Compact — only 7-5/8" x 2-7/8" x 2"
* Complete with holding tray for 4 chips

UVS-11E...................... $69.95

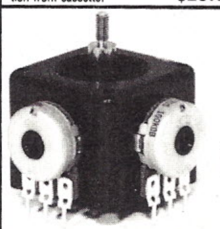
IDEAL FOR TRS 80

CASSETTE CONTROLLER

"Plug/Jack interface to any computer system requiring remote control of cassette functions"

The CC100 controls cassette motor functions, monitors tape location with its internal speaker and requires no power. Eliminates the plugging and unplugging of cables during computer loading operation from cassette.

#CC-100 $29.50



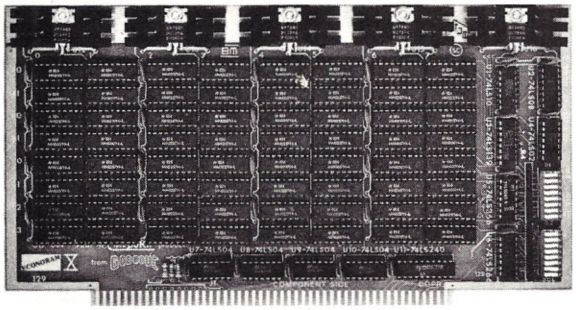
new

Micro-Miniature Joystick

* 2 each 100K pots (Linear Taper)
* Printed Circuit Board Mount
* Size: 1" x 1-3/16" x 1-3/16"

Micro-Miniature Joystick $4.95

We supply memory.



All our **Econoram*** memory is fully static, zips along at 4 MHz with the Z-80 or 5 MHz with the 8085, supports a number of popular busses, is available from us through computer stores world-wide, includes a 1 year limited warranty, and comes in **three** configurations to suit your needs. For lowest cost, choose an **"unkit"** with sockets and bypass caps pre-soldered in place for an easy, one-evening assembly. When you just can't wait to get going, order our **assembled and tested** version. For critical systems, specify boards qualified under our **Certified System Component (CSC)** high-reliability program. These boards are extensively tested, burned in for 200 hours, and are immediately replaced in event of failure within 1 year of invoice date. Refer to chart below for pricing.

Name	Buss & Notes	Unkit	Assm	CSC
8K Econoram IIA	S-100	**$149**	**$179**	**$239**
16K Econoram IV	S-100	**$269**	**$329**	**$429**
16K Econoram VIIA-16	S-100	**$279**	**$339**	**$439**
24K Econoram VIIA-24	S-100	**$398**	**$485**	**$605**
16K Econoram IX	Dig Grp	**$319**	**$379**	n/a
32K Econoram IX	Dig Grp	**$559**	**$639**	n/a
32K Econoram X	S-100	**$529**	**$649**	**$789**
32K Econoram XI	SBC/BLC	n/a	n/a	**$1050**
16K Econoram XII	S-100 (1)	**$329**	**$419**	**$519**
24K Econoram XII	S-100 (1)	**$429**	**$539**	**$649**
32K Econoram XIII	S-100 (2)	**$559**	**$699**	**$849**
16K Econoram XIV	S-100 (3)	**$289**	**$349**	**$448**
16K Econoram XV-16	H8 (4)	**$329**	**$395**	n/a
32K Econoram XV-32	H8 (4)	**$599**	**$729**	n/a
16K Memory Expansion	(5)	**$87.20**	n/a	n/a

16K x 16 or 32K x 8 Econoram XVI — coming soon!

Notes
(1) Bank select board — 2 independent banks addressable on 8K boundaries.
(2) Bank select board — 2 independent banks addressable on 16K boundaries.
(3) Extended addressing (24 address lines). Single block addressable on 4K boundaries.
(4) Bank select option for implementing memory systems greater than 64K.
(5) Chip set expands memory in Radio Shack-80, Apple, and Exidy Sorcerer machines.

***Econoram** is a trademark of **Godbout Electronics.**

Coming soon: 4 MHz Z-80 CPU board, 5 MHz 8085 CPU board, and the Spectrum Color Graphics Board.

NEW!
The Godbout Box!

By the time you read this, we will be shipping our industrial-grade enclosure. It's perfectly suited to creating a powerful system based on our line of S-100 boards (or anyone else's, if you're so inclined). It's rack mount or desk mount (with sliders for pulling it out of the rack if desired), neat-looking, heavy duty, and comes with the back panel pre-punched to accept a variety of connectors. Oh yes, and let's not forget the power supply for powering all your boards; it comes with the box, too. **See your computer store for details, or write us direct.**

Active Terminator Board — $34.50 kit

Plugs into any S-100 motherboard (although ours don't need it) to reduce ringing, noise, crosstalk, and other buss-related problems. Here is an upgrade that is simple and effective.

We supply the S-100 revival.

Why S-100? Because S-100 machines are not consumer-oriented toys — but flexible, modular, professional-level systems that are easy to upgrade, modify, and adapt to specific applications. As a result, over the years the S-100 buss has proven to be the ideal choice for commercial, industrial, and scientific applications. It doesn't obsolete itself, but simply adapts to innovation.

We use the experience we've acquired in the past, along with the very best technology offered by the present, to build products for the future... products that meet, and often exceed, the demands of the new wave of professional S-100 users. Our expanded S-100 line is the right approach at the right time; we invite you to write for further information.

NEW!
HIGH-PERFORMANCE S-100 MOTHERBOARDS

19 slot: $174 unkit*, $214 assm
12 slot: $129 unkit*, $169 assm
6 slot: $ 89 unkit*, $129 assm

*Edge connectors and termination resistors are pre-soldered in place for assembly.

These 3rd generation motherboards, designed to work with the latest 5 and 10 MHz CPUs coming on line, exceed the latest S-100 specs and offer superior performance. Includes true active termination (with half of the termination load at each end of every buss line), grounded Faraday shield between all buss signal lines to minimize crosstalk, and edge connectors included for all slots. All sizes fit Godbout, Vector, TEI, IMSAI, and similar enclosures.

These high quality motherboards are a welcome addition to any system — or the start of a great one.

NEW!
3P+S "Interfacer II" S-100 I/O board

$189 unkit, $249 assm, $324 CSC

Incorporates 1 channel of serial I/O (with **all** the features of a port from the 2S "Interfacer"), along with 3 full duplex parallel ports. The parallel section uses LSTTL octal latches for latched input and output data with 24 mA drive current, attention/ enable/ and strobe bits for each parallel port (with selectable polarity), interrupts for each input port, and separate 25 pin connectors with power for each channel along with a status port for interrupt mask and port status. All in all, this is an incredibly versatile and flexible board.

NEW!
Memory Management S-100 board

$59 kit, $85 assm, $100 CSC

Now you can add bank select and extended addressing to older S-100 machines like the Altair, IMSAI, Sol, Polymorphic, etc. Either use this board with our new extended addressing boards, or retrofit our high density **Econorams** (the ones with phantom or extra qualifier lines) for use with the **Memory Management Board** to get up to ½ a megabyte of memory space for your computer.

2S "Interfacer" S-100 I/O board

$189 unkit, $249 assm, $324 CSC

Dual serial port with 2 full duplex parallel ports for RS-232 handshake; EIA232C line drivers and receivers (1488, 1489) along with current loop (20 mA) and TTL signals on both ports. On-board crystal controlled timebase with independently selectable Baud rate generators for each port (up to 19.2 KBaud). Hardware UARTs don't tie up the CPU. And, there's much more... this is a no-excuses serial board that does things the others only dream about.

2708 S-100 EROM board — $85 unkit

4 independently addressable 4K blocks, with dipswitch selectable jump start built right into the board. Includes all support chips and manual, but does not included EROMs.

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DIODES/ZENERS

QTY.				
	1N914	100v	10mA	.05
	1N4005	600v	1A	.08
	1N4007	1000v	1A	.15
	1N4148	75v	10mA	.05
	1N4733	5.1v	1 W Zenner	.25
	1N4749	24v	1W	.25
	1N753A	6.2v	500 mW Zener	.25
	1N758A	10v	"	.25
	1N759A	12v	"	.25
	1N5243	13v	"	.25
	1N5244B	14v	"	.25
	1N5245B	15v	"	.25
	1N5349	12v	3W	.25

SOCKETS/BRIDGES

QTY.					
	8-pin	pcb	.16	ww	.35
	14-pin	pcb	.20	ww	.40
	16-pin	pcb	.25	ww	.45
	18-pin	pcb	.30	ww	.95
	20-pin	pcb	.35	ww	1.05
	22-pin	pcb	.40	ww	1.15
	24-pin	pcb	.45	ww	1.25
	28-pin	pcb	.50	ww	1.35
	40-pin	pcb	.55	ww	1.45
	Molex pins .01		To-3 Sockets		.35
	2 Amp Bridge		100-prv		.95
	25 Amp Bridge		200-prv		1.50

TRANSISTORS, LEDS, etc.

QTY.			
	2N2222M	(2N2222 Plastic .10)	.15
	2N2222A		.19
	2N2907A	PNP	.19
	2N3906	PNP (Plastic)	.19
	2N3904	NPN (Plastic)	.19
	2N3054	NPN	.55
	2N3055	NPN 15A 60v	.60
	T1P125	PNP Darlington	1.95
	LED Green,	Red, Clear, Yellow	.19
	D.L.747	7 seg 5/8" High com-anode	1.95
	MAN72	7 seg com-anode (Red)	1.25
	MAN3610	7 seg com-anode (Orange)	1.25
	MAN82A	7 seg com-anode (Yellow)	1.25
	MAN74	7 seg com-cathode (Red)	1.50
	FND359	7 seg com-cathode (Red)	1.25

9000 SERIES

QTY.			QTY.		
	9301	.85		9322	.65
	9309	.50		9601	.30
	9316	1.25		9602	.45

MICRO's, RAMS, CPU's, E-PROMS

QTY.		
	8T13	2.50
	8T23	2.50
	8T24	3.00
	8T97	1.75
	74S188	3.00
	1488	1.25
	1489	1.25
	1702A	6.50
	AM 9050	5.00
	ICM 7207	6.95
	ICM 7208	13.95
	MPS 6520	10.00
	MM 5314	4.00
	MM 5316	4.50
	MM 5387	3.50
	MM 5369	2.95
	TR 1602B	3.95
	UPD 414	4.95
	Z 80 A	19.50
	Z 80	14.50
	Z 80 P10	10.50
	2102	1.45
	2102L	1.75
	2107B-4	4.95
	2114	9.50
	2513 Upper or Lower	7.25
	2708	12.50
	2716 D.S.	29.00
	2716 (5v)	69.00
	2758 (5v)	32.95
	3242	10.50
	4116	13.50
	6800	13.95
	6850	7.95
	8080	9.50
	8085	22.50
	8212	3.75
	8214	4.95
	8216	4.50
	8224	5.25
	8228	6.00
	8251	8.50
	8253	18.50
	8255	9.50
	TMS 4044	10.95

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QTY.			QTY.			QTY.			QTY.		
	7400	.20		7492	.45		74H10	.35		74LS51	.75
	7401	.20		7493	.35		74H11	.25		74LS74	1.50
	7402	.20		7494	.75		74H15	.45		74LS75	1.20
	7403	.20		7495	.60		74H20	.25		74LS76	.70
	7404	.45		7496	.80		74H21	.25		74LS86	.95
	7405	.35		74100	1.15		74H22	.40		74LS90	.85
	7406	.35		74107	.35		74H30	.30		74LS93	.85
	7407	.55		74121	.45		74H40	.35		74LS96	2.00
	7408	.40		74122	.55		74H50	.30		74LS107	.90
	7409	.25		74123	.55		74H51	.30		74LS109	1.50
	7410	.20		74125	.45		74H52	.20		74LS123	1.95
	7411	.25		74126	.45		74H53	.25		74LS138	2.00
	7412	.25		74132	.75		74H55	.25		74LS151	.95
	7413	.45		74141	.90		74H72	.35		74LS153	1.15
	7414	.95		74145	1.35		74H74	.35		74LS157	1.15
	7416	.25		74150	.85		74H101	.95		74LS160	1.15
	7417	.40		74151	1.15		74H103	.55		74LS164	2.90
	7420	.25		74153	1.15		74H106	1.15		74LS193	2.00
	7426	.25		74154	1.15		74L00	.30		74LS195	1.15
	7427	.25		74156	.70		74L02	.30		74LS244	2.90
	7430	.20		74157	.65		74L03	.35		74LS259	1.50
	7432	.50		74161	.95		74L04	.40		74LS298	1.50
	7437	.20		74163	.85		74L10	.30		74LS367	2.50
	7438	.30		74164	.75		74L20	.45		74LS368	1.25
	7440	.20		74165	1.10		74L30	.55		74LS373	2.50
	7441	1.15		74166	2.25		74L47	1.95		74S00	.60
	7442	.55		74175	.90		74L51	.65		74S02	.45
	7443	.45		74176	.95		74L55	.85		74S03	.35
	7444	.45		74177	1.10		74L72	.65		74S04	.65
	7445	.75		74180	.95		74L73	.70		74S05	.45
	7446	.70		74181	2.25		74L74	.75		74S08	.65
	7447	.70		74182	.75		74L75	1.05		74S10	.45
	7448	.50		74190	1.25		74L85	2.00		74S11	.45
	7450	.25		74191	1.25		74L93	.75		74S20	.35
	7451	.25		74192	.75		74L123	1.95		74S22	.55
	7453	.20		74193	.85		74LS00	.60		74S40	.30
	7454	.25		74194	.95		74LS01	.40		74S50	.30
	7460	.40		74195	.95		74LS02	.55		74S51	.35
	7470	.45		74196	.95		74LS03	.45		74S64	.15
	7472	.40		74197	.95		74LS04	.65		74S74	1.50
	7473	.25		74198	1.45		74LS05	.45		74S112	.60
	7474	.50		74221	2.25		74LS08	.65		74S114	.85
	7475	.35		74298	1.50		74LS09	.45		74S133	.85
	7476	.40		74367	1.35		74LS10	.45		74S140	.75
	7480	.75		75451	.65		74LS11	.45		74S151	.95
	7481	.85		75452	.65		74LS20	.45		74S153	.95
	7482	.95		75491	.65		74LS21	.45		74S157	.98
	7483	.95		75492	.65		74LS22	.45		74S158	.80
	7485	.75		74H00	.20		74LS32	.60		74S194	2.25
	7486	.55		74H01	.30		74LS37	.45		74S196	2.00
	7489	1.05		74H04	.30		74LS38	.65		74S257 (8123)	2.95
	7490	.55		74H05	.25		74LS40	.70		8131	2.75
	7491	.70		74H08	.35		74LS42	1.25			

C MOS

QTY.			QTY.			QTY.			QTY.		
	4000	.20		4018	.75		4037	1.80		4071	.25
	4001	.30		4019	.35		4040	.75		4072	.60
	4002	.25		4020	.85		4041	.69		4081	.30
	4004	3.95		4021	.75		4042	.65		4082	.30
	4006	1.50		4022	.75		4043	.50		4507	.95
	4007	.25		4023	.25		4044	.65		4511	.95
	4008	.75		4024	.75		4046	1.25		4512	1.25
	4009	.35		4025	.25		4047	2.50		4515	2.95
	4010	.35		4026	1.95		4048	1.75		4519	.85
	4011	.35		4027	.35		4049	.65		4522	1.10
	4012	.25		4028	.75		4050	.45		4526	.95
	4013	.40		4029	1.15		4052	.75		4528	1.10
	4014	.75		4030	.30		4053	.95		4529	.95
	4015	.75		4033	1.50		4066	.75		MC14409	14.50
	4016	.35		4034	2.45		4069/74C04	.45		MC14419	4.85
	4017	.75		4035	.75		4070	1.00		74C151	2.50

I^2L, LINEARS, REGULATORS, ETC.

QTY.			QTY.			QTY.		
	MCT2	.95		LM320K24	1.65		LM373	3.95
	8038	3.95		LM320T5(7905)	1.65		LM377	3.95
	LM201	.75		LM320T12	1.65		78L05	.75
	LM301	.45		LM320T15	1.65		78L12	.75
	LM308	.65		LM323K	5.95		78L15	.75
	LM309H	.85		LM324	1.25		78M05	.75
	LM309 (340K-5)	1.50		LM339	.75		LM380 (8-14 Pin)	1.19
	LM310	.85		7805 (340T5)	1.15		LM709 (8-14 Pin)	.45
	LM311 (8-14 Pin)	.75		LM340T12	.95		LM711	.45
	LM318	1.50		LM340T15	.95		LM723	.40
	LM320H6	.79		LM340T18	.95		LM725	3.50
	LM320H15	.79		LM340T24	.95		LM739	1.50
	LM320H24	.79		LM340K12	1.25		LM741 (8-14)	.45
	LM320K5	1.65		LM340K15	1.25		LM747	1.10
	LM320K12	1.65		LM340K18	1.25		LM1307	1.75
	LM320K15	1.65		LM340K24	1.25		LM1458	.65
							LM3900	1.50
							NE555	.45
							NE556	.85
							NE565	1.15
							NE566	1.25
							NE567	.95
							TA7205	4.95
							76477	2.95
							95H90	9.95

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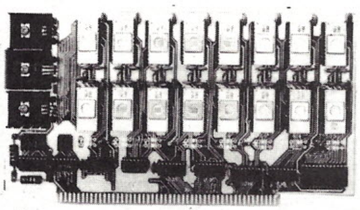
16K EPROM CARD-S 100 BUSS



$59.95 KIT

OUR BEST SELLING KIT!

USES 2708's!

Thousands of personal and business systems around the world use this board with complete satisfaction. Puts 16K of software on line at **ALL TIMES!** Kit features a top quality soldermasked and silk-screened PC board and first run parts and sockets. All parts (except 2708's) are included. Any number of EPROM locations may be disabled to avoid any memory conflicts. Fully buffered and has WAIT STATE capabilities.

OUR 450NS 2708'S ARE $8.95 EA. WITH PURCHASE OF KIT

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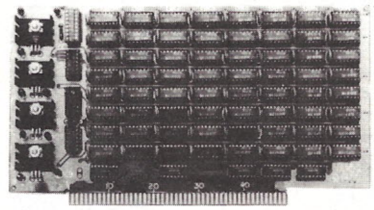
8K LOW POWER RAM KIT-S 100 BUSS

SALE



PRICE CUT!

$119.50 KIT

(450 NS RAMS!)

Thousands of computer systems rely on this rugged, work horse, RAM board. Designed for error-free, NO HASSLE, systems use.

KIT FEATURES:

1. Doubled sided PC Board with solder mask and silk screen layout. Gold plated contact fingers.
2. All sockets included.
3. Fully buffered on all address and data lines.
4. Phantom is jumper selectable to pin 67.
5. FOUR 7805 regulators are provided on card.

Blank PC Board w/Documentation **$29.95**
Low Profile Socket Set...**13.50**
Support IC's (TTL & Regulators) **$9.75**
Bypass CAP's (Disc & Tantalums) **$4.50**

ASSEMBLED AND FULLY BURNED IN ADD $30

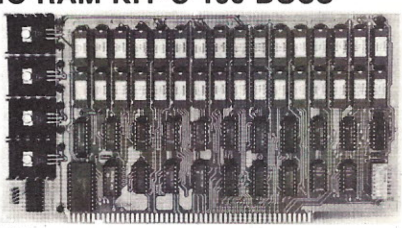
16K STATIC RAM KIT-S 100 BUSS

PRICE CUT!

$279 KIT

FOR 250NS ADD $10

FULLY STATIC, AT DYNAMIC PRICES



WHY THE 2114 RAM CHIP?

We feel the 2114 will be the next industry standard RAM chip (like the 2102 was). This means price, availability, and quality will all be good! Next, the 2114 is FULLY STATIC! We feel this is the **ONLY** way to go on the S-100 Buss! We've all heard the HORROR stories about some Dynamic Ram Boards having trouble with DMA and FLOPPY DISC DRIVES. Who needs these kinds of problems? And finally, even among other 4K Static RAM's the 2114 stands out! Not all 4K static Rams are created equal! Some of the other 4K's have **clocked** chip enable lines and various timing windows **just as critical** as Dynamic RAM's. Some of our competitor's 16K boards use these "tricky" devices. But not us! The 2114 is the ONLY logical choice for a trouble-free, straightforward design.

KIT FEATURES:

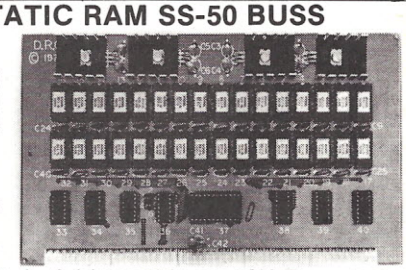
1. Addressable as four separate 4K Blocks.
2. ON BOARD BANK SELECT circuitry. (Cromemco Standard!). Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 2 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

BLANK PC BOARD W/DATA—**$33**
LOW PROFILE SOCKET SET—**$12**
ASSEMBLED & TESTED—**ADD $30**
SUPPORT IC'S & CAPS—**$19.95**

16K STATIC RAM SS-50 BUSS

PRICE CUT!

$275 KIT



FULLY STATIC AT DYNAMIC PRICES

FOR SWTPC 6800 BUSS!

ASSEMBLED AND TESTED - $30

KIT FEATURES:

1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Runs at Full Speed
4. Double sided PC Board. Solder mask and silk screened layout. Gold fingers.
5. All Parts and Sockets included
6. Low Power: Under 2 Amps Typical

BLANK PC BOARD—**$33**
COMPLETE SOCKET SET—**$12**
SUPPORT IC'S AND CAPS—**$19.95**

S-100 Z80 CPU CARD

ASSEMBLED AND TESTED! READY TO USE! Over 3 years of design efforts were required to produce a **TRUE** S-100 Z80 CPU at a genuinely bargain price! **4 MHZ! $159.95**

FEATURES:

- 2 or 4 MHZ Operation.
- Generates MWRITE, so no front panel required.
- Jump on reset capability
- 8080 Signals emulated for S-100 compatability.
- Top Quality PCB, Silk Screened, Solder Masked, Gold Plated Contact Fingers.

Perfect For OEM's

LOW POWER - 250NS
2114 RAM SALE!

4K STATIC RAM'S. MAJOR BRAND, NEW PARTS. These are the most sought after 2114's, LOW POWER and 250NS FAST.

SPECIAL SALE: **$7.50 ea. or 8 For $55**
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16K S-100 Dynamic Ram Board - $149.95

ORIGINALLY PRICED AT $429 each!

We purchased the remaining inventory of PT's popular 16K Ram Board when they recently closed their plant. Don't miss the boat! These are brand new, fully tested, ASSEMBLED and ready to go. All are sold with our standard 90 day limited warranty!!

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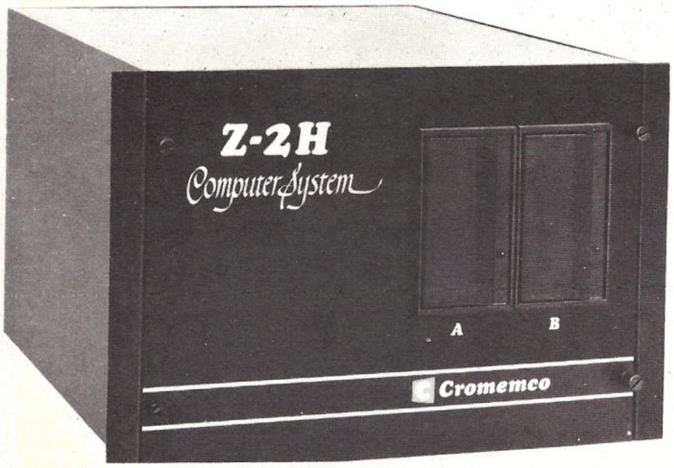

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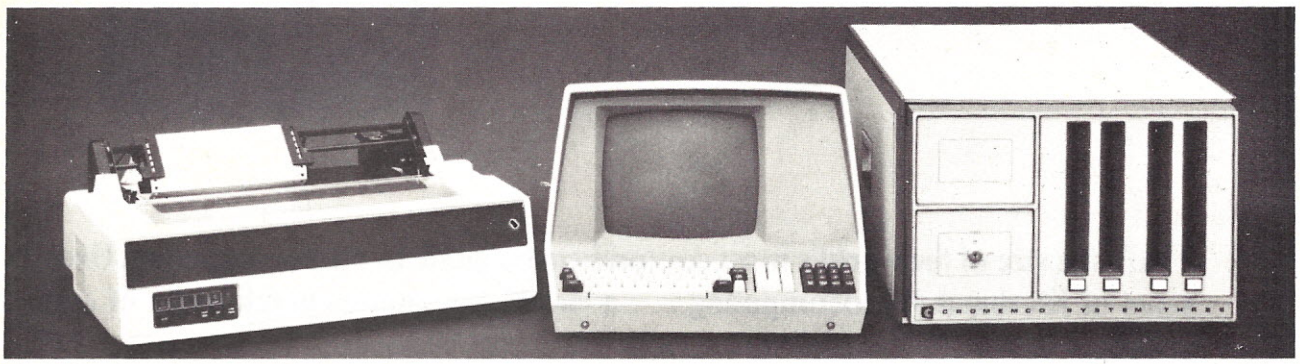

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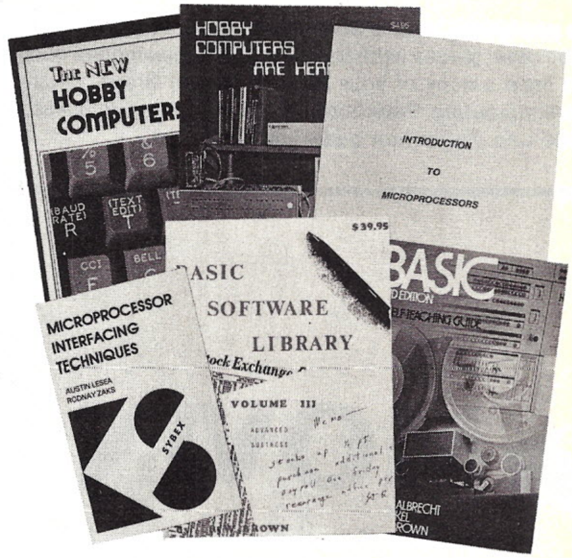

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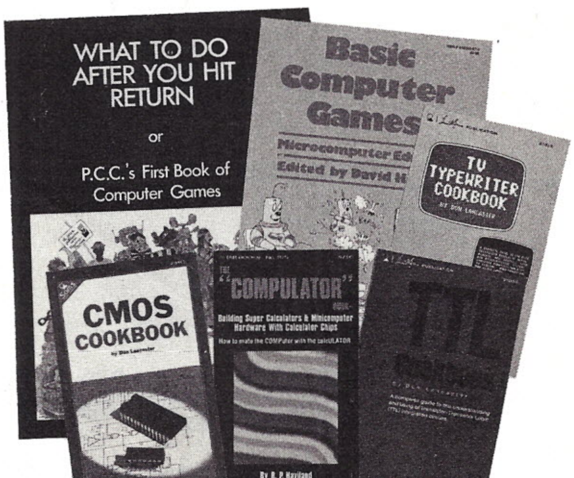

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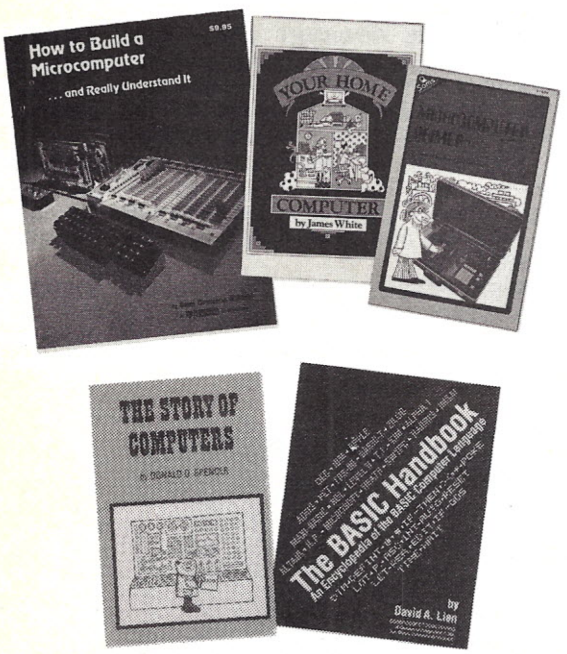

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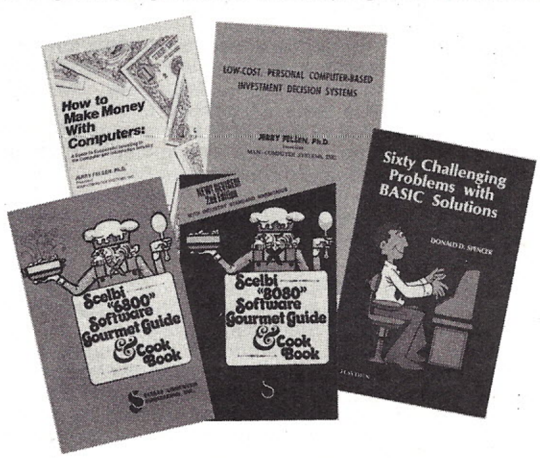

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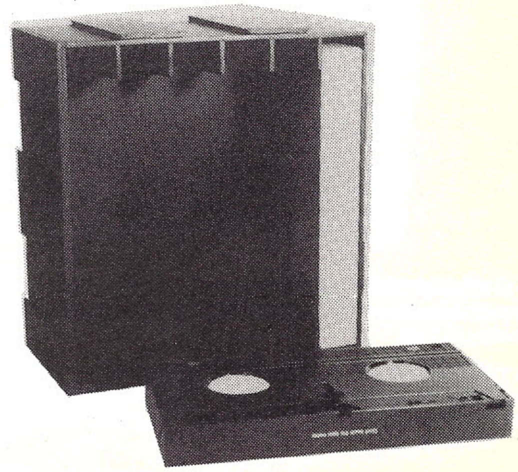

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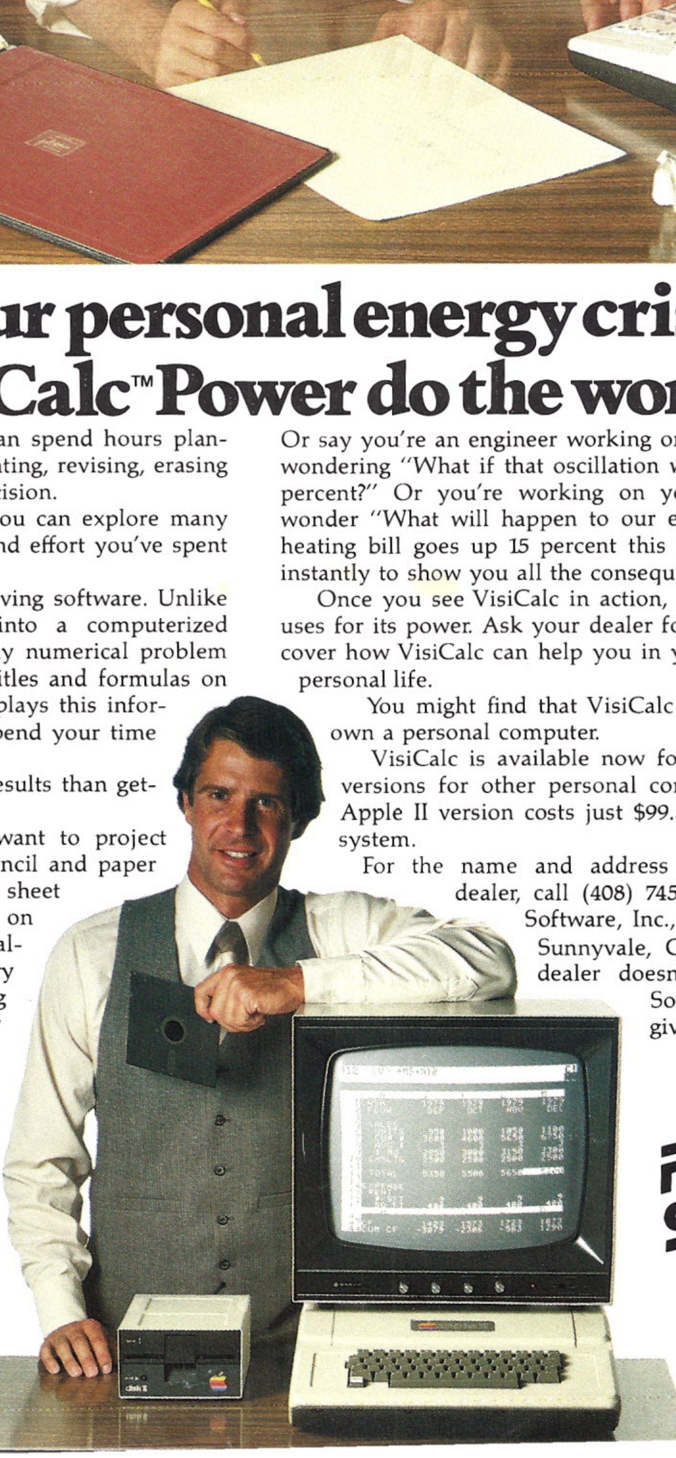

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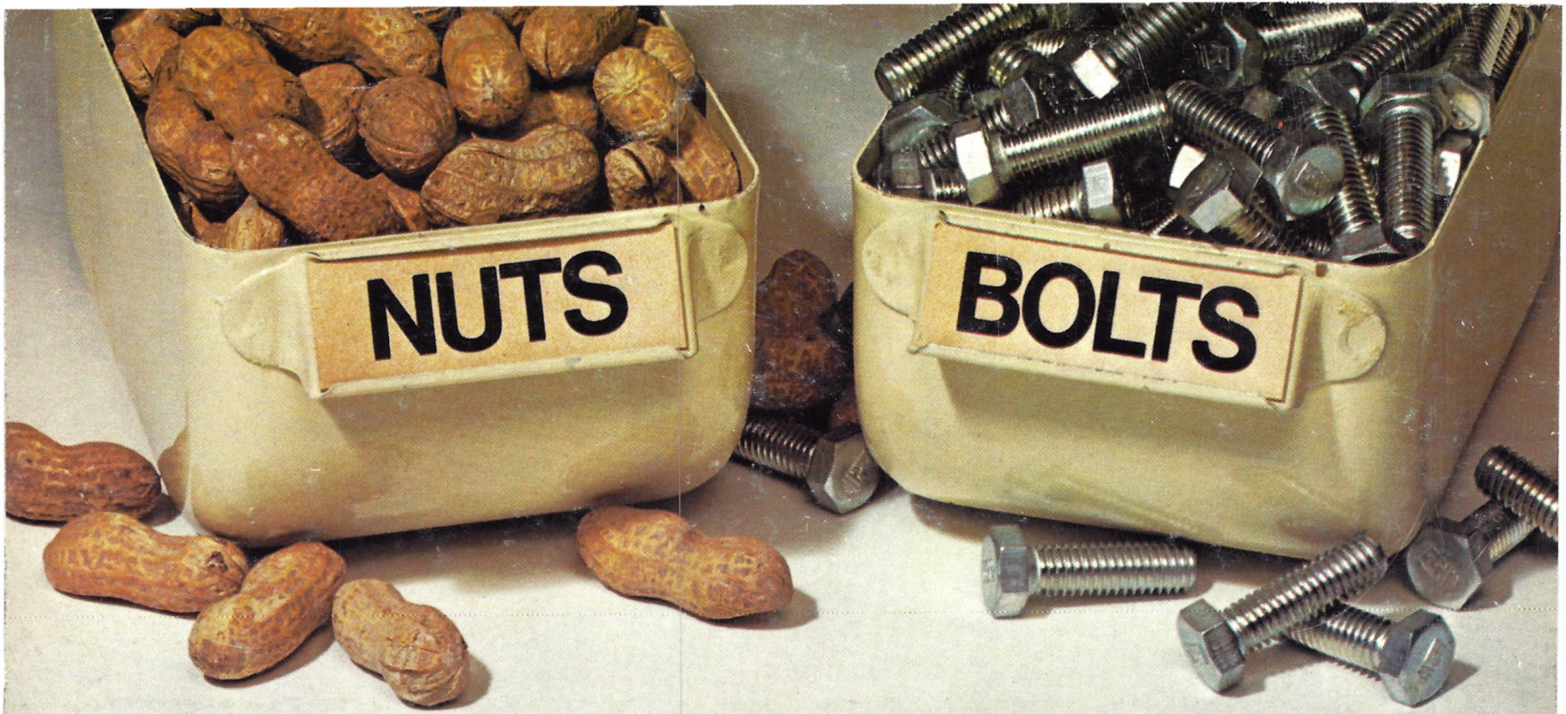

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